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The Engineer.

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OFFICE FOR ADVERTISEMENTS & PUBLICATION, 33, NORFOLK ST., STRAND, LONDON, W.C. 2.

VOL. CXLVI.—No. 3800] LONDON: FRIDAY EVENING, NOVEMBER 9, 1928 [PRICE ONE SHILLING BY INLAND POST 1s. 3d.

The Engineer

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PUBLIC NOTICES

The Director-General, India Store Department, Belvedere-road, Lambeth, S.E. 1, invites TENDERS for :—
SCHEDULE 1. 14,000ft. CASING TUBES, M.S. Lap-welded or solid drawn, 7in. to 15in.
SCHEDULE 2. 7 WORKSHOP BODIES for 3-Wheeled chassis.
SCHEDULE 3. WHEELS, AXLES, and CONNECTING RODS for Locomotives.
Tenders due on the 16th November, 1928, for No. 1; on the 20th November, 1928, for No. 2; and on the 23rd November, 1928, for No. 3.
Forms of Tender obtainable from the above at a fee (which will not be returned) of 5s. for each schedule. 164

Assistant Engineer REQUIRED for Waterworks Construction in NIGERIA under Consulting Engineers. Required to sail on the 5th of December for a tour of 12 to 18 months' service. Salary £600 a year; free quarters and passages; outfit allowance of £60 on first appointment; liberal leave on full salary. Candidates, age 27 to 32, must be Associate Members of the Institution of Civil Engineers and preferably have had some experience on Waterworks Construction.—Apply AT ONCE by letter, stating age, qualifications and particulars of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/987. 114

Assistant Waterworks ENGINEERS (2) REQUIRED by the GOVERNMENT of NIGERIA for the Public Works Department for two tours of not less than 12 nor more than 18 months' service and possible extension. Salary £480 for the first three years, then £510, rising by annual increments to £920 a year. Outfit allowance of £60 on first appointment. Free quarters and passages and liberal leave on full salary. Candidates must have attained the age of 24 and must not be more than 35. They must have obtained an Engineering Degree at a recognised University or have passed Sections "A" and "B" of the A.M.I.C.E. Examination, or the Associateship in Civil Engineering of the City and Guilds Institute, or possess such other Degree, Diploma or Distinction in Engineering as may be considered satisfactory. They must have had experience under a qualified civil engineer on the design of waterworks schemes, and preference will be given to those who have also had practical experience on the construction of such works with engineers or contractors.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/959. 113

Ministry of Transport.
ROADS DEPARTMENT.
APPLICATIONS are INVITED for APPOINTMENT as TEMPORARY ASSISTANT ENGINEER for Road Survey and Inspection Work in the London traffic area. The salary ranges between £300 and £350 per annum inclusive.
Candidates should be practical and experienced men with a knowledge of local administration and of modern road and bridge construction. Knowledge of railway location and construction would be an advantage. Preference will be given to men who have served in H.M. Forces.
Application forms can be obtained from the ESTABLISHMENT OFFICER, Ministry of Transport, Whitehall-gardens, S.W. 1, to whom they should be returned not later than 21st November. 143

City of Birmingham Education COMMITTEE.
ASTON TECHNICAL COLLEGE.
APPLICATIONS are INVITED for the POST of LECTURER in MECHANICAL ENGINEERING. The position is a whole-time appointment, commencing January 1st next. Salary in accordance with the Burnham Scale. Particulars of the appointment will be sent, on receipt of a stamped addressed foolscap envelope, by the undersigned, to whom applications, on the special form provided, must be returned not later than Friday, November 16th, 1928.
P. D. INNES,
9061 Chief Education Officer.

PATENTS AND DESIGNS ACTS, 1907 TO 1928.
Notice is Hereby Given that EDWIN WILDT, HENRY HAROLD HOLMES, British subjects, and WILDT and COMPANY, Limited, a British Company, all of Adelaide Works, Leicester, SEEK LEAVE to AMEND the SPECIFICATION of the APPLICATION for LETTERS PATENT No. 293,059, for an invention entitled "Improvements in or relating to Knitting Machines."
Particulars of the proposed Amendment were set forth in the Illustrated Official Journal (Patents) of the 31st October, 1928.
Any person, or persons, may give Notice of Opposition to the Amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton-buildings, London, W.C. 2, within one calendar month from the date of the said Journal.
W. TEMPLE FRANKS,
118 Comptroller-General.

Alton Urban District Council.
WATERWORKS.
PUMPING MACHINERY.
The Council are prepared to receive TENDERS for the REMOVAL and DISPOSAL of EXISTING PLANT, the PROVISION of TEMPORARY PLANT, and the SUPPLY and ERECTION of NEW PUMPING PLANT, with other ancillary work, at the Waterworks Pumping Station, Windmill Hill, Alton, Hants.
The New Plant comprises Two Sets of Crude Oil Engines (which must be of a type convertible to suction gas) and Turbine, or other Well Pumps, together with Accessory Plant.
The specification may be seen and copies obtained with form of Tender at the offices of the Consulting Engineers, Messrs. H. Rofe and Son, MM. Inst. C.E., 208, Abbey House, Victoria-street, Westminster, S.W. 1, upon the payment (by cheque) of the sum of Five Guineas, which will be returned only after the receipt of a bona fide Tender.
Tenders to be sent to the undersigned on or before Twelve o'clock Noon of Friday, November 23rd, 1928, endorsed "Tender for Pumping Machinery."
The acceptance of a Tender will be subject to the approval of the Ministry of Health, and the Council do not bind themselves to accept the lowest or any Tender.
W. BRADLY TRIMMER,
Clerk to the Council
The Town Hall, Alton, Hants,
October 23rd, 1928. 9883

PUBLIC NOTICES

Administrative County of LONDON.
The London County Council invites TENDERS for the CONSTRUCTION of a NEW BY-PASS ROAD, including a BRIDGE over the Beverley-road, near Hoggers Corner, Upper Richmond-road.
The specification, form of Tender, &c., may be obtained on and after Monday, 12th November, 1928, on application to the Chief Engineer at the Old County Hall, Spring-gardens, S.W. 1, upon payment of the sum of £2, which must be made by cheque, draft or money order to the order of the London County Council. This amount will be returnable only if the tenderer shall have sent in a bona fide Tender and shall not have withdrawn the same. Full particulars of the work may be obtained on personal application, and the contract documents may be inspected before the payment of the fee.
Correspondence or remittances by post should be addressed to the Chief Engineer, at the Old County Hall, Spring-gardens, S.W. 1, but if personal application is made it should be to Room 3a at No. 3, Warwick House-street, Cockspur-street, S.W. 1.
The contractor will be bound to observe the provisions of a fair wages clause, the terms of which are set out fully in the instructions for Tender and form of contract, and in "The London County Council Gazette."
No Tender received by the Clerk of the Council, the County Hall, Westminster Bridge, S.E.1, after 4 p.m. on Monday, 3rd December, 1928, will be considered.
The Council does not bind itself to accept the lowest or any Tender.
MONTAGU H. COX,
138 Clerk to the London County Council.

County Borough of Darlington.
FOR SALE.
ECONOMISERS, FEED PUMPS, FEED WATER HEATER, INDUCED DRAUGHT FAN, &c.
The Electricity Committee of the Darlington Corporation invite TENDERS for the PURCHASE of TWO GREEN'S ECONOMISERS (192 pipes each), 160 lb. boiler pressure, TWO J. P. HALL'S 50,000 lb. per hour VERTICAL DIRECT-ACTING FEED PUMPS, ONE 25,000 lb. per hour BERRYMAN TUBULAR FEED HEATER, ONE MUSGRAVE INDUCED DRAUGHT FAN with 48 H.P. WESTINGHOUSE MOTOR, and various DAMPERS, &c.
Full specification can be obtained on application to the Borough Electrical Engineer, Haughton-road, Darlington, and Tenders, endorsed "Electrical Plant," must reach me not later than November 22nd, 1928.
H. HOPKINS,
Town Clerk.
Town Clerk's Office, Darlington,
3rd November, 1928. 129

PUBLIC NOTICES

Bengal-Nagpur Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for :—
13,690 STEEL BOILER TUBES.
Specification and form of Tender can be obtained at the Company's Offices, 132, Gresham House, Old Broad-street, London, E.C. 2, on or after Thursday, 8th November, 1928.
A fee of 20s. will be charged for each copy of the specification, which is NOT returnable.
Tenders must be submitted not later than Noon on Monday, 19th November, 1928.
The Directors do not bind themselves to accept the lowest or any Tender, and reserve to themselves the right of reducing or dividing the order.
By Order of the Board,
R. C. VOLKERS,
146 Secretary.

Metropolitan Water Board.
TENDERS FOR THE SUPPLY AND ERECTION OF PUMPING MACHINERY, AT THE WOODFORD PUMPING STATION, FOREST-ROAD, WOODFORD, ESSEX.
The Metropolitan Water Board invite TENDERS for the SUPPLY and ERECTION of THREE HIGH-COMPRESSION HEAVY OIL ENGINES, of approximately 300 B.H.P. each, with reciprocating pumps, &c., at their Woodford Pumping Station, Forest-road, Woodford, Essex.
Forms of Tender, conditions of contract, specification and drawings may be inspected without payment of a fee at the Offices of the Board, Chief Engineer's Department (Room 173), on and after Monday, 19th November, 1928.
Contractors desirous of Tendering may obtain the necessary documents from the Chief Engineer on production of an official receipt for the sum of three guineas, which must be deposited with the Accountant to the Board, and which will be returned on receipt of a bona fide Tender accompanied by all the above-named documents and drawings. Such payments and applications must be made between the hours of 10 a.m. and 4 p.m. (Saturdays 10 a.m. and 12 Noon). Cheques must be made payable to the Metropolitan Water Board and not to individuals.
Tenders, enclosed in sealed envelopes, addressed to the Clerk of the Board and endorsed "Tender for Machinery, Woodford," must be delivered at the Offices of the Board (Room 122) not later than 11 a.m. on Monday, 7th January, 1929.
The Board do not bind themselves to accept the lowest or any Tender.
G. F. STRINGER,
Clerk of the Board.
Offices of the Board,
173, Rosebery-avenue, E.C. 1,
7th November, 1928. 162

PUBLIC NOTICES

Bombay, Baroda and Central INDIA RAILWAY COMPANY.
The Directors are prepared to receive up to Noon on Friday, 30th November, TENDERS for the SUPPLY of :—
ENGINE TURNTABLES.
Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).
The Directors do not bind themselves to accept the lowest or any Tender.
S. G. S. YOUNG,
Secretary.
Offices: The White Mansion,
91, Petty France, Westminster, S.W. 1.
7th November, 1928. 144

South Indian Railway Company, LIMITED.
The Directors are prepared to receive TENDERS for the SUPPLY of :—
LOW TENSION TRANSMISSION LINE MATERIALS.
Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.
Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked :—"Tender for Low Tension Transmission Line Materials," with the name of the firm tendering, must be left with the undersigned not later than 12 Noon on Friday, the 30th November, 1928.
The Directors do not bind themselves to accept the lowest or any Tender.
A charge, which will not be returned, will be made of 10s. for each copy of the specification.
Copies of the drawings may be obtained at the Offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria-street, S.W. 1.
A. MUIRHEAD,
Managing Director.
91, Petty France,
Westminster, S.W. 1.
7th November, 1928. 166

Required Immediately in Steel TWO 500-TON and TWO 250-TON FUEL OIL STORAGE TANKS—equivalent capacity in smaller units will be considered—new or second-hand. If second-hand, must be in first-class condition.
Tenders and specifications by return post to the Engineering Department, THE UNITED GLASS BOTTLE MANFRS., Ltd., St. Helens, Lancs. 9092

City of Bradford.
ELECTRICITY DEPARTMENT.
DEPUTY CITY ELECTRICAL ENGINEER.
APPLICATIONS are INVITED for the POST of DEPUTY CITY ELECTRICAL ENGINEER to the Bradford Corporation.
The person appointed is required to assist the City Electrical Engineer and Manager in all engineering matters, but principally in connection with the generation and distribution of electrical energy.
Applicants must have received a sound technical education, and have practical knowledge of the construction and operation of steam plant, electrical generating and converting plant, and transmission and distribution systems.
The salary attached to the post will be from £750 to £1000 (the prescribed maximum) per annum, and candidates are requested, in making application, to state the salary required.
The successful candidate will be required to devote his whole time to the duties of the office and to reside within the city.
Canvassing members of the Council (either directly or indirectly) will be a disqualification.
Lists of duties and forms on which applications are to be made may be obtained from Mr. Thomas Rose, City Electrical Engineer and Manager, 45 to 59, Sunbridge-road, Bradford.
Applications, endorsed "Deputy City Electrical Engineer," accompanied by COPIES of not more than three recent testimonials (which will not be returned), to be sent in time to reach me not later than the first post on Tuesday, the 20th November, 1928.
N. L. FLEMING,
Town Clerk.
Town Hall, Bradford.
27th October, 1928. 9050

ALUMINIUM FOUNDING.
The Council of the British NON-FERROUS METALS RESEARCH ASSOCIATION, having decided to extend the Association's researches in this field, is prepared to CONSIDER CANDIDATES for the POST of INVESTIGATOR.
Applicants should possess the requisite scientific training in addition to practical works experience, preferably in an Aluminium Foundry, and should be qualified to carry out a works survey and a laboratory investigation into the causes and prevention of unsoundness in castings and ingots of aluminium and its alloys.
Appointment in the first place for one year at a salary of £500 to £600, according to qualifications.
Applications should be addressed to the DIRECTOR, BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION, 71, Temple-row, Birmingham. 139

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For Advertisement Rates see Leader Page.

SITUATIONS OPEN

COPIES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED

WANTED, ASSISTANT SUPERINTENDENT for large works engaged on light mass production. Successful executive experience as well as good practical knowledge of tools and methods necessary.—Address reply to "EXECUTIVE," Wm. Porteous and Co., Advertising Agents, Glasgow. P5111 A

WANTED, ASSISTANT ENGINEER, by Large Omnibus Company, North of England. Commencing salary £400 per annum. Applicants must have had experience in similar capacity. State full particulars and enclose copies of three recent testimonials.—Address, 137, The Engineer Office. 137 A

WANTED by Leading Engineering Insurance Company, additional INSPECTORS, fully qualified in best Crane and Lift Practice. Age 28 to 32. Commencing salary £260 per annum.—Address, with full particulars of experience, age, &c., 136, The Engineer Office. 136 A

WANTED, Capable STEEL WORK ERECTOR, accustomed to take full charge of erection of Steel Workshop Buildings. Must be thoroughly capable of controlling all classes of labour on work of this description. Applications to give full particulars as regards previous experience, age, and salary required.—Address, 130, The Engineer Office. 130 A

WANTED, for a Firm of English Structural Engineers in India, an OFFICE MANAGER and CHIEF DESIGNER. Knowledge of Bridgework essential and must have had both Works and Administrative experience. Age about 33. Commencing remuneration the equivalent of £2000 per annum, with prospects of considerable advancement.—Write, with full particulars of career, and, if possible, a photograph to Z. K. 889, c.o. Deacon's Advertising Agency, Fenchurch-avenue, London. All applications will be treated as strictly confidential. 157 A

WANTED for India, ELECTRICAL ENGINEER, to Take Charge of existing Electricity Supply Undertaking. Experience of Diesel Engines, Mains and Consumers' Accounts essential. Age 28-35, single. Free quarters and pay with allowances equivalent to about £1000 per annum.—Address, P5163, The Engineer Office. P5163 A

WANTED for India, ELECTRICAL ENGINEER, for Calcutta Office managing Electricity Supply Undertakings. Experience in Electricity Supply essential. Age 25-35, single. Salary to commence with equivalent to about £800 per annum. Good future prospects for suitable candidate.—Address, with full details of training and education, P5164, The Engineer Office. P5164 A

CHIEF ESTIMATOR WANTED for Large Firm of Lancashire Constructional Engineers. Age 30/35. Must be experienced in pricing, all classes of constructional work; also be able to control staff and deal with sales, correspondence, tenders, &c.—Address, stating age, experience, and salary required, 160, The Engineer Office. 160 A

CORRESPONDENCE ENGINEER.—WANTED, a trained ENGINEER of good education, for Conducting the Technical Correspondence of an important Firm of Pump Makers. Age about 27-36. Salary and prospects according to experience and ability.—Address, 122, The Engineer Office. 122 A

DREDGING MASTER. Thoroughly Experienced in Handling Large Dredger, REQUIRED at once for work on East African Coast.—Reply by letter only, giving full particulars as to experience, positions held, salary required, &c., and two recent references, to PAULING and CO., Ltd., 26, Victoria-street, Westminster, London, S.W. 1. 145 A

ENGINEER REQUIRED to Take Charge of Existing Plant, Purchase Fuel, Stores, &c.; must have thorough practical knowledge of Steam and Electric Plant, Wire rolling and Drawing Mills, and ancillary plant, also Bar Drawing, Strip Rolling, both hot and cold, heating furnaces, &c.—Write, in strict confidence, giving experience, age and salary required, to SECRETARY, Arthur Lee and Sons, Ltd., Crown Steel and Wire Mills, Sheffield. 152 A

ENGINEER REQUIRED, with Practical Experience in the Sale of Aerial Ropeways, Conveyors and Haulage Plants at home and abroad.—Write, Box 559, c.o. Judd's, 47, Gresham-street, London, E.C. 2. 141 A

JUNIOR ENGINEER, with Drawing-office and workshop experience, WANTED, to Supervise Erection anywhere this country. Must have combustion experience. Salary £23 monthly. State age and previous career.—Address, 119, The Engineer Office. 119 A

LECTURER REQUIRED, with Technical and practical knowledge of Moth and Gipsy Constructions and Maintenance. General information on flying.—Apply, GENERAL MANAGER, The De Havilland Aircraft Co., Ltd., Stag-lane, Edgware, stating full experience. 131 A

MECHANICAL ENGINEER is REQUIRED as Supervisor of Fleet of Robey Wagons; commercial and organising knowledge essential; salary £350.—Write, stating age, qualifications, &c., to MANAGER, East Anglian Roadstone and Transport Co., Ltd., Salhouse-road, Norwich. 123 A

METAL FINISHING.—MANAGER REQUIRED to Develop this Department. Must have expert chemical and practical knowledge of iron and steel combined with thorough experience in creating and developing sales, both by correspondence and personal calls. Established connection with users of small iron and steel parts an advantage. Splendid opportunity for young man with the necessary qualifications.—Write, giving full details of education, experience, age, and salary required, to Box 157, Potter's Advtg. Agency, Imperial House, Kingsway, W.C. 2. 111 A

NORTHERN ENGINEERING FIRM REQUIRE ENGINEER to Supervise Foundry and Machine Shop employing about 150 workmen. Applicants should also have Commercial Experience and be capable of dealing with Assistant General Manager's duties. State fully experience, age and salary required.—Address, 140, The Engineer Office. 140 A

OPENING AVAILABLE with Firm of Westminster Export Engineers for JUNIOR who has served apprenticeship to be trained in commercial business; public school boy preferred. Commencing nominal salary 30s. per week; prospects in India.—Address, giving details of apprenticeship and refs., 125, The Engineer Office. 125 A

PRODUCTION MANAGER.—ELECTRICAL MANUFACTURERS (Midlands) REQUIRE capable and experienced MAN to organise for and obtain rapid and economical production. Electrical knowledge useful, but not absolutely essential. Capacity for hard effective work and proved organising ability indispensable. Those possessing these qualifications are invited to state, in confidence, age, experience, salary required, and when free.—Address, 128, The Engineer Office. 128 A

REINFORCED CONCRETE DESIGNER.—A VACANCY occurs for an ENGINEER having specialist experience in Reinforced Concrete Design. Applications should give in confidence a brief summary of experience, age, and salary required.—Address, 112, The Engineer Office. 112 A

REQUIRED for South America, Competent ENGINEER (bachelor), through knowledge Mirrlees and other Diesel Engines; must be first-class Electrician, knowledge Spanish.—Reply, full particulars, age, qualifications, &c., to Box Y. D., c.o. Davies, 95, Bishopsgate, E.C. 2. 147 A

WANTED AT ONCE, TWO Good GENERAL SENIOR DRAUGHTSMEN, preferably with modern Cement Works experience.—Address, 124, The Engineer Office, giving full details of experience and copies of references. 124 A

WANTED by Well-known Firm in the Midlands, SEVERAL First-class DRAUGHTSMEN, accustomed to Crane Work.—Address, 127, The Engineer Office. 127 A

WANTED, SENIOR DRAUGHTSMAN, Accustomed to Design of Milling Machines; good salary to highly efficient designer.—Address, 150, The Engineer Office 150 A

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I/We will return it to you in five days or send you 5/- within ten days from receipt and 5/- monthly until the sum of 30/- is paid in full. Foreign orders cash with order, 30/- plus 1/3 postage.

Signature.....

Address.....

* *Firm*..... * *Position*.....

* For our reference files only. We do not write for references. E.

SITUATIONS OPEN (continued)

WANTED, CHIEF DRAUGHTSMAN, Thoroughly accustomed Hydraulic Press Trade. Prospect of interest for the right man.—Address in confidence, giving age, experience, and wages expected, P5156, The Engineer Office. P5156 A

WANTED, TWO or THREE DRAUGHTSMEN for Oil Engine Designing and Development Work. Previous experience essential.—Address, stating qualifications and salary required, 106, The Engineer Office. 106 A

WANTED, YOUNG LEADING DRAUGHTSMAN, with thorough knowledge of Tea Machinery; good prospects for right man. State age, experience and salary required.—Address, 161, The Engineer Office. 161 A

CHIEF DRAUGHTSMAN (LOCOMOTIVE).—Applications in writing will be considered, till 30th November, for fully qualified ENGINEER. Must have held a similar position in the Drawing-office of a Locomotive Engineering Firm of good standing. State experience, if any, in steam turbines and internal combustion engines.—Apply, giving full particulars and testimonials (copies only), to NORTH BRITISH LOCOMOTIVE COMPANY, Limited, 110, Flemington-street, Glasgow. P5166 A

DRAUGHTSMAN (Engineer), Accustomed to Design and General Lay-out of Pumping Machinery and Auxiliary Plant, Estimating, &c.—Address, stating age, experience, and salary required, 9672, The Engineer Office. 9672 A

DRAUGHTSMEN REQUIRED, Eastern Counties; well experienced Cranes, Capstans, Lifting Machinery. Futile for those without adequate experience in these specialities to apply.—Address, stating age, experience, salary, and when free, P5175, The Engineer Office. P5175 A

DRAUGHTSMAN REQUIRED in the Midlands for Traction Control Gear. Applicants must have had previous experience in this class of apparatus.—Address, stating age, experience and salary required, 9904, The Engineer Office. 9904 A

DRAUGHTSMEN REQUIRED, London District, for Estimating, experienced in Structural and Mechanical Engineering as applied to Conveying and Transporting Machinery. State experience, salary required and when disengaged.—Address, 132, The Engineer Office. 132 A

DRAUGHTSMEN (SENIOR) WANTED for Steam Turbine Details.—Write, stating age, experience, salary and date free, to CHIEF DRAUGHTSMAN, English Electric Company, Ltd., Rugby. 154 A

DRAUGHTSMAN, with Good Experience in Designing Quarry Machinery, Stonebreakers, Granulators, Concrete Mixers, &c., REQUIRED by Leicester firm.—Address fully, stating experience, salary required, &c., 151, The Engineer Office. 151 A

EXPERIENCED DESIGNERS REQUIRED by Engineering firm, 15 miles from Charing Cross; only those conversant with recent practice in Passenger and Commercial Vehicle Design need apply, giving resume of training, experience and salary required.—Address, 9912, The Engineer Office. 9912 A

FIRST-CLASS DESIGNER REQUIRED for Modern Laundry Machines; must have good engineering knowledge, but previous experience in design of Laundry Machines not essential. Applicants must state age, full experience, and salary required, to LAUNDRY DEPARTMENT, Baker Perkins, Limited, Westwood Works, Peterborough. 158 A

JIG and TOOL DRAUGHTSMAN for Textile Machinery, or one experienced in jig work and able to make drawings and sketches.—Apply, with full particulars of past experience and salary required, to URQUHART LINDSAY, Blackness Foundry, Dundee. 163 A

JUNIOR DRAUGHTSMAN WANTED in South England.—Address, with particulars of age, experience, and wages required, 121, The Engineer Office. 121 A

JUNIOR STEELWORK DETAIL DRAUGHTSMAN WANTED IMMEDIATELY, about £3 10s. Call or write, state age, experience and salary required.—FAIRWEATHER and RANGER, 111, Charing Cross-Road, W.C. 2. P5174 A

SENIOR and JUNIOR DRAUGHTSMAN REQUIRED in the Midlands for the Design of Oil Circuit Breakers, &c.—Address, stating age, experience and salary required, 9905, The Engineer Office. 9905 A

SECTIONAL MACHINE SHOP FOREMAN.—REQUIRED, the SERVICES of a thoroughly experienced SECTIONAL MACHINE SHOP FOREMAN in a modern Engineering Works in the Midlands, engaged on medium and heavy type Crane Work. Must have had at least 5 years' experience in a thoroughly modern plant and be practically acquainted with the latest types of labour-saving machinery, including Gear-cutting Machines. A sound progressive job for the right man.—Address, P5150, The Engineer Office. P5150 A

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AN ENGINEER, Fully Qualified, of Proved Inventive ability, offers his SERVICES (part or whole time). Experienced Technical Adviser; thoroughly efficient Designer; used to intricate automatic machines, &c. Competent to develop schemes. Highly successful record; held important posts. Wide and varied experience. Has made several valuable inventions. First-class Diplomas; first-class B. of. T. Cert.; M.I.N.A., &c. Fluent French; age 40. Highest references.—Address, P5173, The Engineer Office. P5173 B

CHARTERED CIVIL ENGINEER, With Wide experience, seeks EMPLOYMENT as REPRESENTATIVE of large Engineering Firm, or could Act as Secretary to Engineering College, Technical Board or Company.—Address, P5099, The Engineer Office P5099 B

B.SC. (26), with Unique Combination Engineering and commercial experience, 5 years shops, D.O., rate fixing, and estimating; last 3½ years in general commercial office, correspondence, sales, advertising, now SEEKS POSITION as Commercial Manager (or similar post) in small engineering firm.—Address, P5165, The Engineer Office. P5165 B

DESIGNER-DRAUGHTSMAN (Mech.) (25), Structural, hydraulic and general engineering experience, SEEKS POST in London.—H. G. W., 175, Vauxhall Bridge-road, S.W. 1. P5170 B

ENGINEER DESIRES POSITION Abroad. Mechanical, constructional, electrical, internal combustion, machine shop; competent plans, estimates, native labour. Last position 9 years. Excellent references.—SIDDOWN, Sunnyhill, Halton, Leeds. P5162 B

ENGINEER (27), First-class Experience in Design and estimating all types of R.C. structures, DESIRES POST, home or abroad; previous experience abroad.—Address, P5141, The Engineer Office. P5141 B

ENGINEER MANAGER, Having Extensive Experience in control, organisation and development of business, home and overseas, sound and varied technical knowledge, DESIRES APPOINTMENT; highest references.—Address, P5119, The Engineer Office. P5119 B

ENGINEER, 29, Public School Education, Extensive experience Pulverised Fuel, Shop and D.O. training, DESIRES CHANGE. Seeks POST with progressive firm.—Address, P5171, The Engineer Office. P5171 B

For continuation of Small Advertisements see page 3.

A Seven-Day Journal

Rationalisation of London Traffic.

A REPORT on the common management of London's transport facilities was submitted by a Special Committee on Traffic to the London County Council at its meeting on Tuesday of this week. The Special Committee is entirely satisfied that the rationalisation of passenger-carrying conditions would be wholly to the benefit of the people of London, and would result in many extensions of travelling facilities. It recommends, therefore, that legislation should be promoted in the Parliamentary session of 1929 to enable the Council to enter into agreements with the Underground group of railways and others embodying the principles of common management and a common fund. The Committee has given much consideration to the position of the Council's tramways and the capital expenditure on them as affected by the proposed scheme of rationalisation. The fact that a local authority owning a tramway undertaking has to set aside annually out of revenue or rates a sum sufficient to meet interest on and repayment of the debt raised for the purposes of the undertaking distinguishes municipal capital from private capital invested in the transport industry. The Committee therefore feels that in any scheme for the unified operation of London local passenger transport services a proportion of the capital expended by the Council on its tramways should rank as a prior charge in relation to the common fund. The portion so related would be in a position comparable with that of the debentures or preference stock of the companies associated with the scheme. The Committee's recommendations were received with much hostility by the Labour members of the Council. The debate was continued into the early hours of Wednesday morning. Eventually, shortly after 6 a.m., the Council agreed to its Committee's recommendations by a majority of 63 votes to 44.

Foreign Naval Contracts.

THERE is reason to hope that an important addition will soon be made to the number of naval contracts which are now being carried out in this country for foreign Governments. The Chilean Government is anxious to have its battleship "Almirante Latorre" refitted, and a party of officials from Devonport Dockyard are now on their way to Valparaiso in order to survey the vessel, the British Admiralty having signified its readiness to submit a tender for the work. The party consists of Mr. G. A. Bassett, senior constructor; Mr. Owen, inspector of shipwrights; Engineer-Commander S. J. B. Huxham, R.N., and Mr. G. L. H. Brough, assistant electrical engineer. As the battleship in question was not only built and equipped in this country, but served in the Grand Fleet throughout the war as a unit of the Royal Navy, it is natural that the Chilean authorities should wish her to be renovated here. She was laid down by Armstrong, Whitworth and Co., at Newcastle-on-Tyne, in November, 1911, to Chilean order, but on the outbreak of war was purchased by the British Admiralty and completed as H.M.S. "Canada." She has a normal displacement of 28,000 tons, turbine machinery of 37,000 S.H.P. for a speed of 22·75 knots, and a main armament of ten 14in. guns, her armour protection being less massive than that of contemporary British battleships. The vessel gave a good account of herself at Jutland, and in April, 1920, was re-purchased by Chile. A sister ship, "Almirante Cochrane," was retained by the British Navy, and is now in service as the air-craft carrier "Eagle." It is of interest to recall that other South American battleships of the Dreadnought type have been modernised since the war in United States yards, the Argentine ships "Rivadavia" and "Moreno" by their original builders, and the Brazilian ships "Minas Geraes" and "Sao Paulo" at the Government dockyard in New York.

Retirement of Sir Henry Maybury.

IT was officially announced on Tuesday last that Sir Henry Maybury, Director-General of Roads at the Ministry of Transport, is to resign from that position at the end of this year. Sir Henry, who is sixty-four, was born at Uffington, near Shrewsbury. His first professional education was received in the office of Mr. R. E. Johnston, chief engineer of the London and North-Western and Great Western Joint Railways. After a period of about five years he joined a firm of public works contractors and eventually became general manager. In 1892 he was given an appointment under the Festiniog Local Board and at a later date he was employed under the Malvern Urban Council. In 1904 he became County Surveyor of Kent and in 1913 was appointed Chief Engineer to the Road Board. In 1916 the Government created him a Brigadier-General and deputed him to organise the road system for the troops in France. In this office he was responsible for the construction and upkeep of thousands of miles of roads and similar works, and had under his command 350 officers, 13,600 skilled roads and quarry troops, and some 30,000 unskilled troops. For his services he was given the C.B. and Legion of Honour in 1917 and the K.C.M.G. in 1919. After the war he was appointed Director-General of Roads at the Ministry of Transport, and in December, 1924, he became the first Chairman of the London and Home Counties Traffic Advisory Committee, a body charged with the duty of regulating London traffic. Under his direction over 200 miles of new arterial roadways have been constructed in the London area alone, and through him the road work of 2000 local authorities has been co-ordinated. It is intimated that Sir Henry's services will still be available to the Government in a consultative and advisory capacity with relation to roads and bridges, and it is understood that he will enter into practice as a consulting engineer.

The Fastest Flight.

AFTER a period of waiting for suitable weather conditions, Flight-Lieutenant D'Arcy Greig on Sunday, November 4th, made an attempt to recover for this country the world's flying speed record. When Flight-Lieutenant Webster won last year's Schneider Trophy race at a speed of 281·6 miles an hour, he incidentally established at the same time a world's speed record. The distinction did not, however, remain for long with this country, for shortly afterwards the Italian airman, Major de Bernardi, easily surpassed Flight-Lieutenant Webster's performance with a speed of 296·9 miles an hour. At the beginning of March this year, Flight-Lieutenant Kinkead lost his life in the Solent while attempting to regain the record. At the end of the same month Major de Bernardi succeeded in surpassing his own record and taking the figure to 318·4 miles an hour. On Sunday of this week Flight-Lieutenant Greig achieved a mean speed of 319·17 miles an hour. Although this is the highest speed ever reached, it does not surpass the previous record by the margin of at least 5 m.p.h. required to make it an official world's speed record. Lieutenant Greig's machine was the "Supermarine-Napier S5" mono-seaplane on which Flight-Lieutenant Webster won the Schneider Trophy race, with various adjustments and improvements. On his fastest lap Flight-Lieutenant Greig's speed rose to 322·63 miles an hour.

A Railway Diamond Jubilee.

THIS week the Metropolitan District Railway is celebrating the sixtieth anniversary of the opening of its first section. On October 1st, 1868, the High-street, Kensington, to Gloucester-road portion of the company's line was brought into service, and on December 24th of the same year the route was extended from the second named station to Westminster. The extension to Mansion House was opened in July, 1871, but it was not until October, 1884, that the extension eastwards beyond Mansion House to effect a junction with the East London Railway at Whitechapel and to complete the "Inner Circle" was brought into service. An experimental electric service between Earl's Court and High-street, Kensington, was established in May, 1900—at 1s. per passenger—but it was withdrawn in November of the same year. The real beginning of electric working dates from June, 1903, when the South Harrow electric line was opened between Hanger Lane and Park Royal. On November 5th, 1905, all steam trains were withdrawn from the company's system. To mark the jubilee the company is exhibiting at South Kensington Station until to-morrow, November 10th, a train composed of a steam locomotive representing the period from 1868 to 1905, a passenger coach of the same period, a "Southend" electric locomotive of 1905, an all-wood electric car of the same date, an all-steel electric car of 1920, and an example of the latest 1928 type of electric car. The new type of car is one of a consignment of 101 now being delivered.

Pulverised Fuel for Marine Purposes.

IN a public statement recently issued the Admiralty has made clear its attitude towards the carrying out of experimental work connected with the burning of powdered coal aboard ships. It states that while it is fully aware of the importance to the country of such work, there is little probability that pulverised fuel will ever replace oil fuel for naval vessels. While the Admiralty for this reason may not be itself directly interested in carrying out such work, and is not making experiments, it has, nevertheless, received as sympathetically as possible applications which have been made to it to facilitate the experiments carried out by other interests, with a view to developing the use of powdered coal for merchant vessels. In a Journal note in our issue of July 27th we referred to the sloop "Hollyhock," which has been made available by the Admiralty to the Department of Scientific and Industrial Research for experimental work connected with the use of pulverised fuel at sea. It is now further announced by the Admiralty that in response to an application made by the Brand Powdered Fuel System, Ltd., the surplus submarine depôt ship "Maidstone" has been offered to that company for experimental work. The "Maidstone" was built by Scott's Shipbuilding and Engineering Company, Ltd., at Greenock, in 1912, and is a 355ft. steamship of about 3600 tons. Her engines are of 2800 horse-power and are capable of giving her a speed of about 14·3 knots. The coal capacity of the ship is about 465 tons. A pulverising equipment will be put on board and the two boilers fitted with the Brand powdered fuel system. The loading and unloading of powdered fuel into bunkers and its distribution to the burners according to the Brand system is also to be demonstrated.

The Airship Graf Zeppelin.

AFTER spending a fortnight or so in the United States, the Zeppelin airship "Graf Zeppelin" left Lakehurst on the morning of Monday, October 29th, on her return flight to Friedrichshafen. Carrying crew and passengers numbering sixty-four in all, she followed a northerly course, and arrived over Friedrichshafen in the early hours of Thursday, November 1st. The journey lasted 68½ hours, and the average speed maintained was over 60 miles an hour. On the whole, the vessel's double trip has not been completely satisfactory. Dr. Eckener himself, the designer and navigator of the vessel, has stated that in his opinion the "Graf Zeppelin" is finished with so far as any regular passenger service is concerned, and that swifter and more strongly constructed airships are required to maintain a Transatlantic service. He particularly emphasises the view that more powerful engines are required in order that the vessel may at no time be left at the mercy of the weather. In expressing these views with such frankness, Dr. Eckener has heartened those interested in the building of the British airships "R 100" and "R 101." Both these vessels are about 1½ times as large as the "Graf Zeppelin," and in the case at least of the Government airship "R 101," are constructed on an entirely new system possessing, it is claimed, remarkable strength properties. The engine power, in spite of the increased capacity, is not, however, greatly different. The German vessel is equipped with five 570 horse-power Maybach engines, while the "R 101" will be driven by five 585 horse-power Beardmore "Tornado" engines using heavy fuel oil.

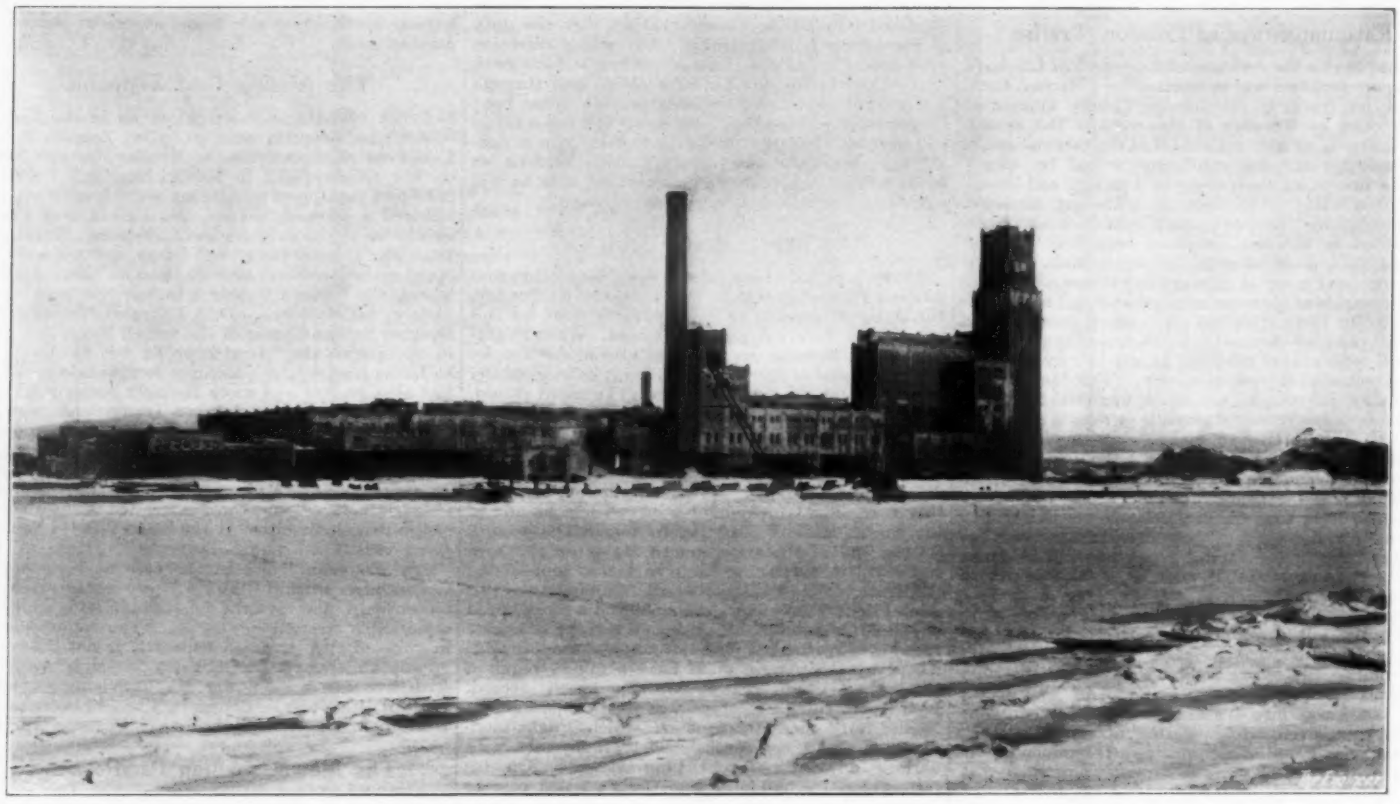
The New Canadian Pacific Liner.

THE new 40,000 gross ton quadruple-screw liner which has been ordered by the Canadian Pacific Railway Company from John Brown and Co., Ltd., Clydebank, promises to be a steamship of outstanding interest. She is to be named the "Empress of Britain," and will have a speed of 24 knots, which should enable her to make the voyage from Southampton, *viâ* Cherbourg, to Quebec in five days. With her length of 700ft. and beam of 97ft., she will be the largest liner built on the Clyde since John Brown and Co., Ltd., completed the Cunarder "Aquitania" in 1914. Following his successful employment of high-pressure geared turbines with combined water-tube and Scotch boilers designed for a pressure of 350 lb. per square inch and a total temperature of 680 deg. Fah. in the recent C.P.R. liners of the "Duchess" class, Mr. Johnson has gone a step further in the machinery for the new liner. She will be a four-screw ship, with four sets of high-pressure geared turbines. The two inboard turbines are each to be designed to develop one-third of the total power required, and each will be fitted with an astern running turbine. The two outboard sets, on the other hand, will be ahead turbines only, and each of them will be designed to develop about one-sixth of the total power. There are to be nine oil-fired water-tube boilers of Yarrow design, with a maximum pressure of 425 lb. and a working steam pressure of 375 lb., the total steam temperature being about 700 deg. Fah. Two auxiliary Scotch boilers will be employed, and the auxiliary electric generating plant will include both I.C. sets and turbo-generator sets, and most of the engine-room and deck auxiliaries will be electrically operated. The propelling machinery will be constructed by John Brown and Co., Ltd.

Salvage Operations at Scapa Flow.

WE are pleased to hear that Cox and Danks, Ltd., were successful on Friday of last week, November 2nd, in floating upside down the 24,600 gross tons ex-German battle-cruiser "Seydlitz," which was sunk on her side in Scapa Flow. The work of turning the vessel completely upside down and floating her has proved to be the most difficult task yet undertaken, and Mr. E. F. Cox and all his staff are to be congratulated on the final success which has attended their very patient and arduous efforts. When floated the upturned hull had only a list of 1½ deg. to starboard, and on Saturday last the hull, with the accompanying docks, was towed over 2 miles in the direction of Lyness Pier. Owing, however, to the neap tides then prevailing, it was not possible to pass the shallow waters of Gutter Sound. On Monday next, November 12th, the towing operation is to be completed, the spring tide then giving an extra depth of over 6ft. The same day it is hoped to beach the ship at the firm's Lyness depôt, and during the winter months the bulkheads will be made good and strengthened ready for towing the upturned hull to Rosyth Dockyard in April next. Work is now proceeding on the 24,700 gross tons battleship "Kaiser," which is lying upside down with a list of about 10 deg. The main inlets to the hull have all been concreted up, and it only remains to fix the air locks and make good the bulkheads.

NEWSPRINT MILL OF ANGLO-CANADIAN PULP AND PAPER MILLS, LTD.



VIEW OF THE MILL ACROSS THE ST. CHARLES RIVER

A Large Canadian Newsprint Paper Mill.

One of the best laid-out and most completely equipped manufacturing plants at work on the North American Continent is the new mill of Anglo-Canadian Pulp and Paper Mills, Ltd., which is situated at the confluence of the St. Charles and St. Lawrence rivers is admirable for many reasons. All coal, sulphur, limestone and other supplies used in the enterprise can be, and are delivered by water and unloaded at its own wharf. Much of the paper that is made at this plant will be shipped by water, especially to such ports as New York, Philadelphia, and Baltimore. With its works built at tide-water level, the company is in an excellent position to buy pulpwood on the open market, because all boats on the St. Lawrence pass its very doors at both low and high tides.

The mill is supplied with electrical energy from the Duke-Price development at Isle Maligne on the Saguenay River in the Lake St. John District of Quebec, where 360,000 horse-power is produced. A double transmission line, on steel towers, 140 miles long, carries the power to the sub-station of the Anglo-Canadian plant, the pressure employed on this line being 187,000 volts.

The mill is equipped with four 234in. high-speed paper machines, designed to run at 1400ft. per minute. At peak speed, each machine is capable of producing 175 tons of newsprint daily. It is interesting to note that these machines were built in England and that the orders for them were placed on a strictly competitive basis.

In every department in this extensive plant mechanical devices have been employed to replace hand labour wherever it has been possible to do so. The wood storage facilities are sufficient to accommodate 125,000 cords at one time, so that continuous operation of the mill is assured. When the wood arrives at the mill from Montmorency, Quebec, it is unloaded on to a link-belt conveyor which carries the sticks to the washing room. It is then delivered mechanically to great bins over the hydraulic magazine grinders and the two chippers, provision having been made for a third chipper. These bins are not on top of the

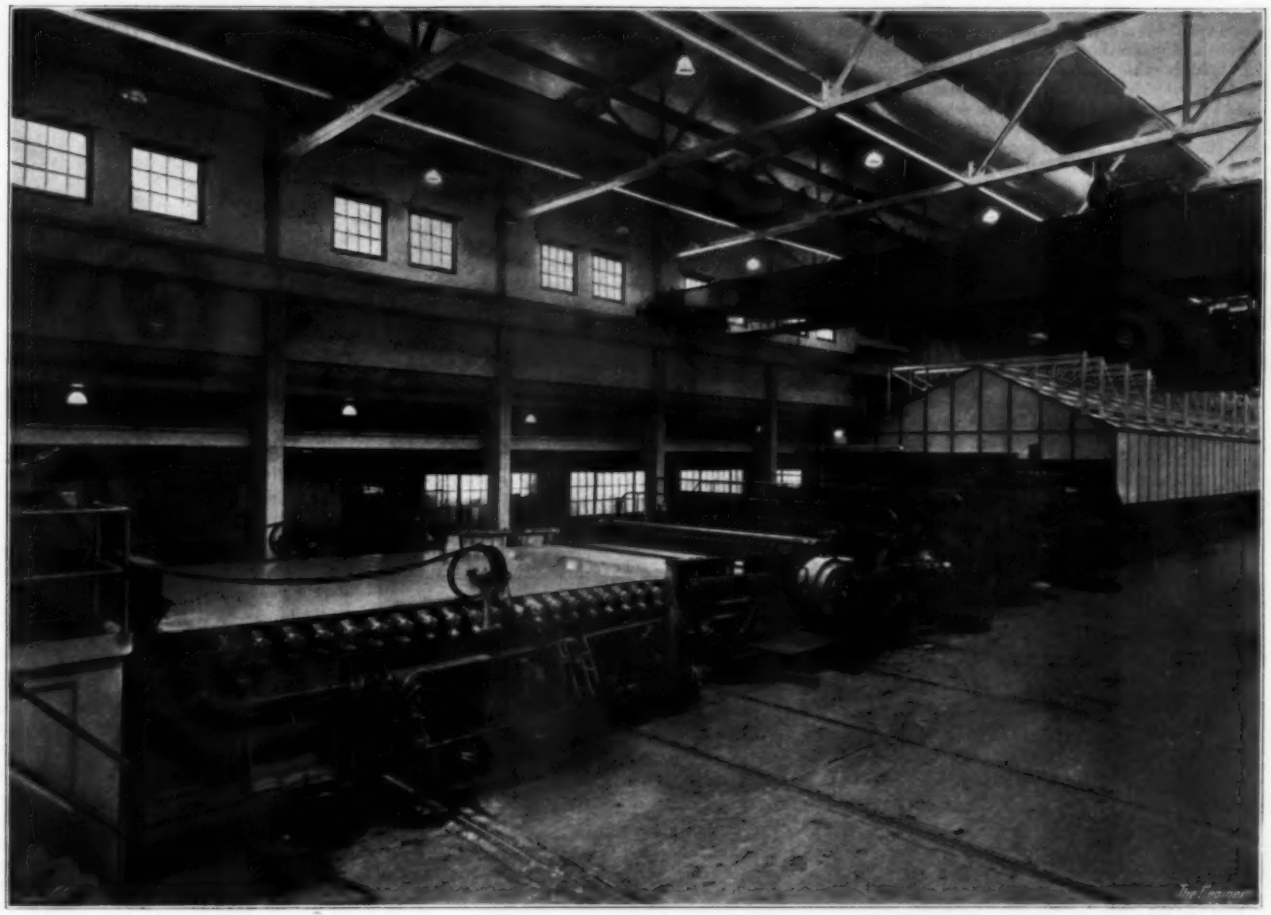
BOILER-HOUSE

COAL WEIGHING LORRY

Rivers at Quebec City, in the Province of Quebec. This mill comprises a self-contained newsprint manufacturing plant built and equipped with every modern device from the basement to the roof, and from the wood room to the top of the acid tower. The mill proper is 850ft. long and 580ft. wide; the sulphite tower rises to a height of 225ft.; the chimney is 223ft. 6in. high, and the actual area of the whole site comprises almost one hundred acres.

The position of the mill at the junction of the two

A NEWSPRINT PAPER MILL AT QUEBEC



FOURDRINIER PAPER MACHINE

WET ENDS OF MACHINES NOS. 1 AND 2

digester house, but on the inside, with ample air space between the walls of the house and the bins, so that there is little or no danger of chips becoming frozen. The link belt conveyor runs directly over the bins, where trippers regulate the distribution of the chips into the bins, which are directly over the four digesters. These digesters measure 15ft. by 54ft. A foundation has already been laid for a fifth digester.

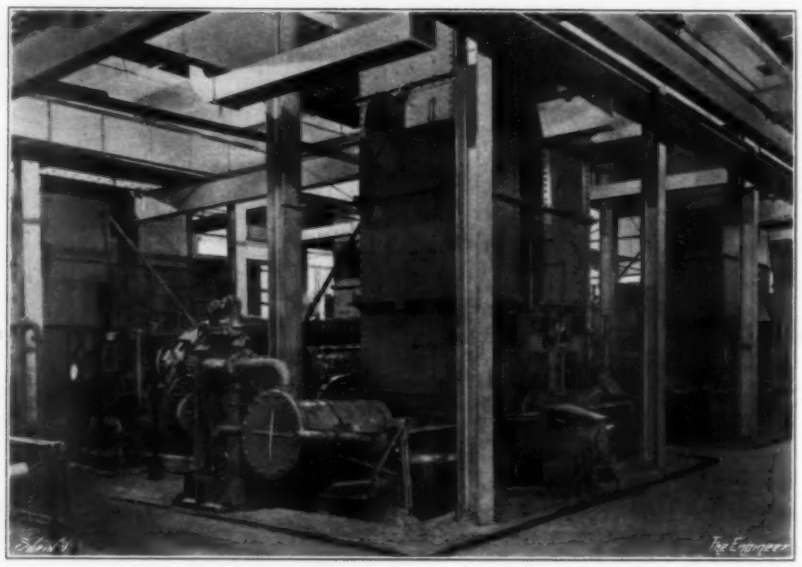
One corner of the digester house rises into the imposing tower, 225ft. high, which contains two acid towers, 90ft. high, with plenty of room for two more. High above the acid containers is a water tank, which has a capacity of 125,000 gallons. The acid plant has a production of 150 tons of sulphite daily, but that quantity can be increased to meet larger demand. The various positions of the sulphur burners, gas cooler, gas fan, acid pumps, settling tank and other equipment have been specially laid out to facilitate the operation of this department. The entire acid system is easy to operate and presents one of the neatest and most businesslike installations on the Continent. Down in the blow pits, the sulphite cook is not blown. Instead, when the cook is finished, the liquor is relayed back to the two acid accumulators instead of going to waste. The digester is then filled with water and the pulp is washed by gravity into the blow pit, so that the pulp actually receives its first washing while in the digester and then receives a second washing in the blow pit. The theory of doing away with blowing the digesters is that the forcible ejection of the fibres out of the digester and against the sides of the pit is injurious both to the strength and to length of the fibres and that, if the pulp is allowed to flow out by gravity, a stronger and longer fibre is assured.

The pulp is removed from the blow pits by an arrangement consisting of light spiral screws which move the pulp into a pulp digger or bucket conveyor on which it is carried to Swedish pulp separators whence it runs by gravity through the knotters. The pulp diggers are moved by means of an electrical trolley the entire length of the blow pits. From the knotters the sulphite pulp passes through fine screens to one of a battery of nine filters, in which it is thickened, and then discharged into a chest directly below the filters. The filter installation at this mill is believed to be unique. Water is withdrawn from the pulp in the filters by means of vacuum. There are eight other filters, six used for ground wood pulp and two for recirculated stock, acting as savealls for the surplus paper machine white paper produced in the mill. Control throughout the whole flow is quite simple.

In the ground wood department, the sticks are loaded from the bins on the floor directly above the grinder room into the grinder magazines by hand. There are twenty of these grinders and the grinder room is looked upon as being as near to perfection as possible. It is equipped with overhead cranes and hoists that are transferable from one series of tracks to another, and these tracks even run through the 22in. of space between the twin magazines with which each grinder is fitted. There are two magazines feeding wood on to each stone, the logs being held against each side of the stone by hydraulic pressure that is under constant regulation. This grinder room, as is the case in every department of the big mill, is equipped with a panel which communicates direct with the substation control so as to insure safety and at the same time eliminate waste of power. From the grinders, the pulp goes through three bull screens and then through fine screens, after which it is thickened up in the filters and discharged into a chest below.

The raw materials converge in the one mixing room and are passed on in a straight line to the paper machine, being at all times under the control of regulators. This mixing room is situated as near the centre of the entire plant as it is possible to be in conformity with the progressive and orderly movement of the raw material on its way to complete conversion. The proportion of each of the three stocks from the sulphite groundwood and reclaimed stock chests is controlled by metering systems, one for each pair of paper machines, and the proportion of each stock is readily regulated to meet any condition. The pulp then passes to the mixed stock chest and then on through the metering stuff boxes which are arranged at the head of each paper machine. The speed with which the stock is passed by this box is synchronised with that of the paper machine, with no necessity for stuff gate adjustment.

The paper machines themselves are excellent examples of mechanical engineering. Stone rolls are used on all presses and all of the felt rolls run in roller bearings, as also do the table rolls, the driver felt rolls, and the wire rolls. There are forty-six dryers, 5ft. in diameter, with a hood over each set. All of the machines are equipped with automatic oiling systems. When the rolls of paper are taken off the winders, they are placed on a specially designed wrapping machine directly behind and less than 15ft. away, its position having been specially chosen to save as much time, space and labour as possible. The paper then travels over a roller runway to a scale and, after weighing, the rolls are discharged to a de-elevator, as it is called, which lowers them to the shipping room complete and ready to be placed on the cars. There are special machines for the ventilation of the paper machines and for the drawing off of the vapour, and all parts of the plant have special systems for heating and ventilating and for the drawing away of heat generated by motors, so as to maintain the air pure and temperature conditions correct.



HYDRAULIC MAGAZINE GRINDER

Everything about the mill is on a big scale. For instance, the electric power is received from the main transmission lines through a new design of porcelain oil-filled wall bushings and oil circuit breakers designed to have a rupturing capacity of 300,000 volts, an arrangement which, in its scope, is said to be equalled only by the southern California Edison electric plant. There are 450 motors of different capacity ranging from 1 H.P. to 900 H.P. in the mill.

The mill was designed by George F. Hardy, who is well known in Canada as a paper mill architect and engineer.

Lord Rothermere is President of the Anglo-Canadian Pulp and Paper Mills, Ltd. Mr. F. W. Clarke, who is also President of the Gulf Pulp and Paper Company, of Clarke City, Quebec, and is a former President of the Canadian Pulp and Paper Association, is Vice-president; while Mr. R. A. McInnis, who was manager of the Abitibi Power and Paper Company from 1917 to 1926, when he resigned to become identified with the Anglo-Canadian enterprise, is the general manager of the company.

Various views of the mill are given herewith, and on page 507. The view at the head of the article shows the mill as seen from across the St. Charles River. Other views in the text show the hydraulic magazine grinders, the range of Babcock and Wilcox boilers, and the coal weigher at the rear of the boilers respectively. The two views on page 507 show a Fourdrinnier paper machine, and the aisle between the wet ends of the paper machines.

INSTITUTION OF NAVAL ARCHITECTS.—The date for the opening of the next annual meetings of the Institution will fall on Wednesday, March 20th, 1929. The Council is arranging, on the invitation of the Registro Italiano, of Rome, to hold a summer meeting in Italy on September 15th to 29th, 1929, visiting Rome, Genoa, Venice and Trieste.

Transport at Home and Abroad.*

PROGRESS in almost all branches of engineering has been so rapid that it seems advisable to pause for a moment and reflect on the strides made in the past, the happenings of the day, and the road along which we are likely to travel in the future.

TRANSPORT.

The most noticeable progress has been made in connection with transport, and even if we confine our attention in this review to transport by land we shall have a sufficiently large field to cover.

To-day we have about 180,000 miles of roads, of which 25,000 miles are Class 1. Road capacity cannot be judged simply by mileage. Alignment, width, condition of surface, and, amongst other factors, the type of vehicle, all contribute to the capacity. We are aware of the enormous road traffic existing and ever increasing; whether we have arrived at the maximum permissible weights is doubtful, and it is certain that the number of vehicles using the roads will go on increasing. The traffic statistics show that on eleven selected roads the average number of vehicles passing daily had increased in 1926 by 125 per cent. over the figures for the years immediately preceding the war; and on one of those roads the increase was as much as 700 per cent.

The future of the roads is an interesting question to dwell upon. Are they to go on ever increasing in mileage and tonnage carried, or is the point of saturation approaching, when the railways will relieve the roads, giving them again a rest, as happened at the advent of the railways? Perhaps the most probable outcome is that we shall find that both are needed.

Railways all the world over, in spite of competition, are still the greatest instruments for the movement of passengers and goods on land. It is interesting to note the position to which the railways of the world have attained in recent years. The total mileage varies from year to year, but may be taken approximately at 762,000 route miles; the track mileage cannot be given, as statistics are incomplete. The proportion between the two varies greatly in different countries.

One of the first questions confronting pioneers in railway construction was the gauge to be adopted. Out of the 762,000 route miles of railways in the world, 56·2 per cent. are on the 4ft. 8½in. gauge and 12·8 per cent. on the metre gauge. The 4ft. 8½in. gauge is in excess of half of the total, probably because that gauge was first adopted in this country which, as we all know, was the pioneer country for railway construction. Apart from this, it possesses many advantages; it is broad enough for high speeds and gives good opportunities for the design of suitable locomotives and rolling stock, and, at the same time, is not too wide to preclude the employment of reasonably sharp curves. The next most important gauge is that of 1 m. (3ft. 3⅜in.), which, undoubtedly, is a very useful gauge where first cost is an important consideration and where a broken country has to be traversed.

Except in Great Britain, practically all the railways of the world are laid with flat-bottom rails spiked to timber sleepers, or fastened by various devices to transverse steel sleepers. The flat-bottom rail has proved quite able to do any work demanded of it; for instance, it is in general use in the United States of America, where high speeds and heavy axle loads are common.

Statistics show great variation between different countries as regards the mileage in proportion to area and population. For instance, in Belgium, a very thickly populated country, there is one mile of railway to every 1·88 square mile of area, and to every 1252 of the population; in Great Britain and Ireland, including the Irish Free State, the figures are one mile of railway to every 4·86 square miles of area and every 1897 persons. The figures for Australia, China, and various other countries show what a small railway mileage there is compared with the area or population. It is not suggested that figures such as these give any indication of the requisite railway mileage, but they show that there is still a vast field for railway construction in various parts of the world.

It has often been stated that "trade follows the flag." However that may have been in the past, it is now certain that trade follows capital. It is therefore of great importance to the trade of this country that British capital should be freely invested in undertakings in foreign countries, because not only is a fair return on such capital expected, but the fact that such undertakings are the outcome of British enterprise generally means the employment of British materials in their construction and upkeep, giving employment to manufacturers, shippers and others, and not least to British civil engineers. Railway work in foreign countries is one of the most interesting forms of engineering, and many people think that an engineer's education is hardly complete unless he has had some such experience. However that may be, there is no doubt that experience and the sense of responsibility are more quickly acquired abroad than in the more stereotyped but necessary work usually undertaken, especially by the young engineer, in this country.

* The Institution of Civil Engineers. Presidential address by Sir Brodie Haldane Henderson, K.C.M.G., C.B., November 6th, 1928. Abridged.

At this point the President described the engineering developments in Buenos Aires, Bahia Blanca, Rosario, Rio de Janeiro, Valparaiso, &c., and dealt with some of the railways of South America.

Continuing, he said :—I have described very briefly some of the engineering works in which, as I have stated, British capital and British engineers are interested, but I have only touched the fringe of the subject ; in addition to the harbours and railways, there are many tramways, waterworks, sewerage, electric light and power undertakings, also hydro-electric installations. There would seem to be great scope in the future for this latter method of power production, as magnificent rivers exist, and in Argentina the Iguasu Falls rival in size and grandeur the world-famous falls of Niagara.

As yet these countries are only thinly populated ; they offer a vast field for British enterprise. We, in this country, are inclined to think there are too many people in the world, but in the vast spaces of South America many millions could be accommodated, and it must be remembered that every kind of climate is available.

I have given you this outline of engineering works in South America because I am in close personal touch with many of them, and because I am desirous of exciting your interest in them. I could give you similar statements about work carried out by British engineers in other quarters of the globe, such as China, Africa, and various countries in Europe. So long as such countries continue to develop with the aid of British capital we may look to them to afford a field of work for British engineers, particularly the younger members of the profession ; and the question what qualifications are desirable for those who contemplate an engineering career overseas is one of much interest and importance. It is evident, I think, that the first requisite is a sound knowledge of the fundamental subjects of engineering theory, with a thorough practical training.

In the more highly developed countries, where the old order changes slowly, the specialist—even the young specialist—may find opportunity for the exercise of qualifications based upon experience of limited range ; but in countries in the stage of vigorous development, the man who has been trained on broader lines is more likely to be useful and successful. It is, I believe, one of the reasons for the high repute of the Institution Diploma in South America and elsewhere, that it is guarantee of engineering knowledge, training, and experience of a fundamental character, as well as of a good standard of general education. To men so qualified, the publications which they receive through their membership of the Institution are not only interesting generally, but also of much practical value when they are called upon to meet the varied demands of engineering work in those comparatively new countries.

This country, as is so frequently stated, lives on its overseas trade, and it is only by the free flow of capital into undertakings overseas that this trade can be stimulated and kept in this country. For various reasons during the last few years capital has been somewhat deflected into other directions, but the direction of the flow will change, and when it does, the members of this Institution will, I am sure, be ready and able to play their part and uphold the prestige of the British engineer.

Many problems of great interest still face the engineer on existing railways. In these days of severe competition, every effort must be made to carry freight as cheaply as possible. The permanent way has been improved, but it seems a great pity that in this country foreign timber sleepers are employed. If prejudice could be overcome and steel sleepers employed, a very safe road would be provided and many tons of steel would be used per annum, giving much-needed work to our steel manufacturers. Engineers have produced a quality of rail able to stand up to the severe requirements of present-day traffic ; the cost of bridge maintenance has been reduced ; and in many directions economies, without loss of efficiency, have been introduced. But a good deal remains to be done. For instance, the working of branch lines with small traffic still presents interesting problems. In this country steam rail cars seem, at the moment, to be the favourite method of dealing with the question. In many countries rail cars with internal combustion engines are giving excellent results. Probably the oil engine will be used more and more for this and other services. Experiments are being carried out with oil engines in conjunction with electric motors on the train, so as to obtain the advantages of electrification without its drawbacks.

In addition to the carrying out of experiments in various directions, notable progress has been made in railway working during recent years. One of the most important is the electrification of sections of steam railways. Financially, perhaps, the returns have not in every case come up to expectations, but as regards the convenience of passengers, the results leave little to be desired. If electric power can be produced more cheaply than at present, cautious extensions will doubtless be made, but in this country it is not to be expected that electricity will entirely supplant steam for long-distance hauls and for goods traffic.

Railway engineers now give greater attention than ever to the permanent way, and there is a strong tendency to adopt a heavy rail. Many railways, which a few years back were content with a 75 lb. rail, now require rails weighing 100 lb., and in one country at least rails up to and over 130 lb. per yard are being laid. To some extent this is due to greater axle loads, but it is also claimed that the heavy rail requires less maintenance and gives a smooth running track, with resultant reductions in the rolling stock repairs. The weak point in connection with permanent way is, as always, the rail joint. Many devices have been tried to obtain a better joint than that afforded by the ordinary fishplate, but so far the old method is generally adhered to, although hopes are still entertained that improvement may be effected. Manganese steel is now employed in track construction, with excellent results. Its high cost, however, restricts its use.

Last year the President informed us that the report of the Bridge Stress Committee would shortly be published. It has not yet seen the light of day, but its birth is now near. I am informed that we can really expect it at a very early date, when we hope that the investigations and trials made may enable engineers to pass, as safe, existing bridges which might otherwise be condemned, and that new bridges may be designed on more economical lines.

In one aspect of bridge design we seem, in this country, to lag behind the practice of other countries. Large bridges and roofs are still generally made of ordinary mild steel ; whereas, in other countries, what may be called special steels have been used for many years. British manufacturers are able to produce silicon, nickel, and other varieties of steel giving a high yield point, which have been taken advantage of by ship designers, but have not been utilised to any great extent in the design of bridges and other steel structures. This is probably owing to lack of knowledge regarding the behaviour of such steels under the various conditions which they have to meet. I venture to think that there exists a field for inquiry in connection with the use of these steels which would probably give valuable results.

I have said sufficient to show that engineers are alive to the requirements of modern transport, and are striving in all directions for greater efficiency, but the managerial side of railway enterprise must also look to its laurels. When the railway groups were formed, great hopes were entertained that economies on a large scale would be obtained. It is for others to say if these hopes have been fulfilled.

This country has been going through a period of trade depression which has affected many important classes of engineering, but we are informed that there are indications of better times to come. The members of this Institution will be ready and able to fulfil their duties in connection with such a revival with, I trust, advantage to themselves and benefit to others.

The No. 3 Lister Drive Power Station.

No. IV. (*conclusion*).*

INDEPENDENT evidence of the ability of No. 2 turbo-alternator to uphold the guarantees of steam consumption which it carries was provided in July of this year. At the request of the Corporation, Mr. W. M. Selvey, consulting engineer, assisted by Mr. Wadeson and Mr. Rait, carried out an official test on behalf of the Liverpool Corporation. A comprehensive report on this test has been prepared by Mr. Selvey, and the following notes relating to some of the main points have been taken from that report.

Condensate Measurement.—"Tanks for measuring the condensed steam were erected and calibrated before the test in the presence and under the supervision of Mr. Wadeson. The calibration was effected by adding weighed quantities of water and recording the corresponding scale reading in the gauge glass, showing the depth of water in the tank. The connection to the gauge glass for each tank was taken off from the bottom of the tank, and one gauge glass covered the full height of each tank. During the calibration, the temperature of the water in the gauge glass was taken for each reading. The weighbridge used for the calibration of the tanks had been examined previously and checked by an inspector of weights and measures, and it was returned as correct.

"In actual operation the measurement of the water was always between two readings on the scale, the tank never being fully emptied out. This procedure was adopted partly on account of the added speed of operation which it affords, but it has the additional advantage that no uncertainty as to the drainage of the tank exists. The temperature of the water in the gauge glass was taken for each scale reading and the due temperature correction was made."

Measurement of Electric Output.—"The machine was tested whilst supplying its output to the ordinary service load. Two integrating watthour meters were supplied by the Metropolitan-Vickers Electrical Company for measuring the alternator output. A third meter was also supplied and connected up as a sine meter, for the accurate determination of the power factor. In addition, an indicating Weston wattmeter was connected in the circuit, so that instantaneous readings could be taken of the loading of the machine. A standard voltmeter was coupled across the elements of the set of meters in order to define the voltage at which the instruments had been used. Before the test, two integrating watthour meters and the indicating wattmeter, together with the series and potential transformers, were calibrated at the standardising department of the Manchester School of Technology.

"This calibration was only carried out over a limited range of power factor, since the conditions which would obtain on test were not known at that time. Moreover, the calibration was carried out without the sine meter inserted, as this meter was installed at the request of the independent testing authority. This first calibration was used during the tests for the purpose of setting the load and for calculating approximately the output. Immediately after the tests, the whole set of instruments used on test, together with their transformers, were disconnected and taken by car direct to Manchester for re-calibration.

"At the same time, all details as to the circumstances under which the meters had been used and the readings obtained thereon were communicated to the checking authorities, so that the re-check of the electrical measuring instruments after the tests could be carried out, as near as possible, under similar conditions to those obtaining during the test. It was found on comparing the results of the two calibrations, namely, before and after the test, that they were very close, although a direct comparison could not, of course, be made under the actual test conditions. Such comparison as was possible, however, showed quite definitely that the meters had not altered their registration. For this reason, greater accuracy was obtained in calculating the electrical output, by using that calibration carried out after the test only. As a matter of interest, it may be said that if the average consumption had been calculated by taking the mean results of the two calibrations instead of relying on the second calibration alone, the difference in the final figures would only have been 0·062 per cent. The agreement between the two meters used in simultaneously ascertaining the electrical output was satisfactory. One meter was consistently a little higher than the other and the variation from the mean as affecting the average consumption was 0·093 per cent. These quantities are, of course, entirely negligible, but they go to show how reliable the electrical arrangements were."

Measurement of Steam Conditions.—"As there is a duplicate supply of steam to the stop valve, it was necessary to take pressure and temperature measurements on each supply. The pressures at the stop valve were taken on special 12in. Bourdon type gauges. These and all other gauges, such as were employed for turbine expansion pressures, air pump steam pressures, circulating water pressures, &c., were tested on a deadweight pressure gauge tester by a representative of the independent authority. The position of every gauge and of the measuring point at which the connection to the gauge was made was noted, and any difference in the level was allowed for. The steam temperatures at the stop valve were taken by thermometers, which had been calibrated at the National Physical Laboratory, and the corrections on the certificates were applied.

"The length of any emergent mercury column in the thermometer stem and the temperature of the circumambient atmosphere was noted, and due correction was made."

Measurement of Condensate Temperatures, Vacuum Temperatures and Circulating Water Temperatures.—"The principal low-temperature measurements were taken with a series of calibrated open-scale thermometers of high accuracy. For thermometric measurements of lesser importance, a batch of low-temperature thermometers were checked on site against an open-scale low-temperature standard with an N.P.L. certificate. No thermometer with a large correction was used.

"The circulating water outlet temperature was taken with special precaution, as it has been found that on large condensers, stratification of the water leaving the condenser is apt to occur. An ordinary thermometric measurement in a temperature pocket may then give a misleading reading. To obviate this difficulty a vertical perforated pipe extending the whole way across the section was inserted in each outlet main, and a substantial stream of the circulatting water was steadily drawn off. The temperature measurement was made in the stream. In order to make doubly certain, this procedure was followed in each of the two outlet pipes, and was repeated again after the junction of the two streams. The correct result was taken to be that of the average of the three determinations."

Vacuum Measurements.—"Vacuum measurements were taken at two points 180 deg. apart at right angles to the turbine axis on the turbine exhaust flange. A measurement was also taken on the air suction and two measurements at the top of the exhaust on the breeches piece. Mercury U tubes, equipped with brass scales and Vernier attachments, were used for the vacuum measurement. These readings were corrected to 32 deg. Fah. The barometric pressure was taken by means of two calibrated aneroid instruments, one of which had no correction on it and the other a very small one. These two barometer readings checked out very closely. The instruments were read at the same level as the mercury columns."

Condenser Leakage Tests.—"The condenser was

* No. III. appeared November 2nd.

tested for water-tightness before, during and after the tests, and all condensate escaping from drains and glands was continuously collected and weighed on a platform weighbridge. These various leakages were added to the measured condensate as necessary."

The following table gives the turbine cycle efficiencies on consumption as run. The feed water heaters were in operation during tests 1, 2, 3, and 6, and it is for this reason that the Rankine cycle efficiency has been omitted in these tests. During test No. 4 the feed heaters were by-passed.‡

TABLE A.

Test No.	1	2	3	4	6
Nominal load, kW	18,750	25,000	12,500	25,500	31,250
Fraction of full load	¾	¼	½	¼	⅝
Conditions—					
Steam Pressure at stop valve, lb. per sq. in. abs.	293·1	287·0	297·6	286·3	286·5
Steam temperature at stop valve, deg. Fah.	669·2	693·6	671·1	707·6	694·4
Superheat, deg. Fah.	253·6	280·0	254·1	294·2	280·9
Vacuum absolute pressure, inches Hg	1·94	2·27	1·56	2·47	2·75
Consumption as run, lb. per kWh	10·244	9·969	10·454	9·949	10·226
Adiabatic heat drop, B.Th.U.	427·7	425·0	439·9	424·0	414·8 (?)
Heat extracted per lb. of steam, B.Th.U.	333·1	342·3	326·4	342·9	333·6
Overall Rankine efficiency of turbo-alternator, per cent.	—	—	—	80·88	—
Alternator efficiency,* per cent.	—	—	—	96·40	—
Turbine Rankine efficiency, per cent.	—	—	—	83·90	—
Heat recovered per lb. of steam as electrical output, B.Th.U.	333·1	342·3	326·4	342·9	333·6
Total heat at stop valve per lb. of steam, B.Th.U.	1,357·2	1,370·4	1,357·9	1,377·7	1,370·8
Temperature leaving feed heaters, deg. Fah.	139·4	143·3	132·2	—	149
Heat in condensate, B.Th.U.	107·4	111·5	100·2	83·9	117·1
Heat input, B.Th.U.	1,249·8	1,259·1	1,257·7	1,293·8	1,253·7
Thermodynamic efficiency of turbo-alternator, excluding evaporator, per cent.	26·65	27·18	25·95	26·51	26·61

* Assumed from tests on duplicate alternator.

Observations were also made of the pressure after the governor valve and of the vacuum at the top of the turbine exhaust, or breeches, pipe. The heat drop between these conditions represents the opportunity presented to the turbine nozzles and moving blading for doing work. In continental practice turbine efficiencies are often expressed on this basis, and deduced in this way the Rankine cycle efficiency of the turbine reaches the high figure of 85·37 per cent. The test data relating to this is given in Table B.

TABLE B.

Steam pressure after first governor valve, lb. per square inch abs.	272·9
Total heat in steam, B.Th.U. per lb.	1377·7
Vacuum at top of turbine casing, inches hg. abs.	2·68
Adiabatic heat drop, B.Th.U. per lb.	416·7
Heat extracted per lb., B.Th.U.	342·94
Overall Rankine efficiency of turbo-alternator, per cent.	82·30
Alternator efficiency, per cent.	96·40
Turbine Rankine efficiency, per cent.	85·37

Turbine.—"The turbine shows a remarkably good result, and it would appear that the machine will give a slightly larger output than that specified. This was not actually demonstrated, as regards the overload capacity, on test, as the steam pressure was a little low.

"The highest turbine efficiency calculated on the Rankine cycle from steam conditions before the stop valve to vacuum at the condenser inlet flange was found to be 83·9 per cent. This is an exceedingly good figure and certainly amongst the highest yet attained. It is the highest we know of in any independent test."

Condenser§.—The condenser analysis is given in Table C. "The condenser shows a very good performance, the efficiency is high, and the vacuum attained corresponds to a temperature only from 2 deg. to 4 deg. above the circulating water outlet temperature. The heat transmission rate, which is a figure of merit for comparing condensers, is high, and amongst the best yet found on any plant approaching the size of this. All the results obtained are above $K_{deg} = 600$."

"The condensate withdrawn from the condenser is practically at a temperature corresponding to the vacuum. In some cases it is above the measured exhaust steam temperature, but it is consistently below the temperature corresponding to the measured absolute pressure. The majority of the readings have a difference less than 1 deg. Fah. and the greatest difference, 1·3 deg. Fah., occurs naturally at overload."

Arising out of Mr. Selvey's comments which we have just quoted, it is apparent that when condenser efficiencies of the character which he reports can be achieved, the temperature difference between the vacuum and the outlet circulating water can be kept as small as was formerly the characteristic of jet plant only. It follows that with modern high-efficiency surface condensers the amount of circulating water required could be kept down to the quantity required by a jet condenser. This clearly indicates that the issue between these two types of condensing plant has been completely changed by the progress made with surface condensers.

Overall Plant.—"The plant has fulfilled its guarantees with a margin to the good. The average steam consumption as obtained on test after correction is 4·57 per cent. better than the guaranteed. The best steam consumption as run was 9·949 lb. per kWh. This was on a full-load straight test as near as possible to design conditions, and without the use of heaters or evaporator. Such a result is a remarkably good figure for a cooling tower station with moderate steam conditions and in hot summer weather. The highest overall turbo-generator efficiency on the Rankine cycle is 80·88 per cent. No question of any alternator efficiency comes into this figure. It is efficiency from the steam end to the alternator terminals, and as such is particularly good."

It should be stated that in the deductions made from the tests, Callendar's steam tables have been used throughout. In deducing efficiencies the value 3412 has been taken as the B.Th.U. corresponding to 1 kW hour. It is necessary in considering all such test data to ascertain both the steam table used and the value of this quantity before it is possible to attach precise significance to the deduced figures. There appears to be a very strong case for the adoption of a rigid international convention in regard to this constant, and an even stronger case for the adoption of internationally-agreed steam tables.

Conclusion.—"The plant generally has fulfilled its guarantee of steam consumption efficiency and output in no uncertain way. There is a margin of 4·57 per cent. to the good on the steam consumption, and the figure for full load is probably better than any result attained in this country with plant operating under similar conditions. The whole performance is the best of any of which we have personal knowledge. The turbine shows a very high efficiency and the condensing plant is eminently satisfactory."

TABLE C.—*Condenser Analysis: Heat Balance and Calculation of Circulating Water Quantity.*

Test No.	1	2	3	6
Nominal load fraction of full	¾	¼	½	⅝
Output at alternator terminals, kW	19,775	25,545	12,926	31,188
Alternator efficiency, per cent.	96·05	96·34	94·97	96·51
Output as at coupling, kW	20,588	26,512	13,611	32,316
Add for bearings, oil pump, &c., kW	187	187	187	187
Output as at blades, kW	20,775	26,699	13,798	32,503
Total steam through condenser from turbine and ejectors, lb. per hour	204,423	256,371	136,977	320,675
Heat in steam presented, B.Th.U. per lb.	1,357·2	1,370·4	1,357·9	1,370·8
Heat remaining in condensate, after feed heaters, B.Th.U. per lb.	107·4	111·3	100·2	117·0
Heat in steam, presented, less heat in condensate	1,249·8	1,259·1	1,257·7	1,253·8
Total heat presented, less heat in condensate, B.Th.U. $\times 10^6$	255·488	322·796	172·276	402·062
Heat accounted for as mechanical output as at blades, B.Th.U. $\times 10^6$	70·884	91·097	47·079	110·900
Heat extracted by condenser B.Th.U. $\times 10^6$	184·604	231·699	125·197	291·162
Rise in temperature of circulating water, deg. Fah.	13·43	17·28	9·54	21·9
Circulating water quantity, gallons per hour	1,374,530	1,340,850	1,312,340	1,329,500
Inlet circulating water temperature (t_1), deg. Fah.	83·97	84·61	81·49	85·30
Outlet circulating water temperature (t_2), deg. Fah.	97·4	101·89	91·03	107·2
Average absolute pressure at exhaust flange, inches Hg.	1·94	2·27	1·56	2·75
Corresponding temperature (t) s, deg. Fah.*	100·1	105·4	92·91	111·8
Average observed steam temperature at exhaust flange (t^1) s, deg. Fah.†	99·5	104·7	92·4	112·3
Condensate temperature, deg. Fah.	99·9	104·6	93·1	110·5
Difference between condensate temperature and (t)s,* deg. Fah.	−0·2	−0·8	+0·2	−1·3
Difference between (t)s and outlet circulating water temperature (t_2)	2·7	3·51	1·88	4·6
Surface of condenser, square feet	37,800	37,800	37,800	37,800
Logarithmic heat transfer constants—K on (t)s	649·9	631·7	627·9	615·8
(t^1)s	727·6	697·7	720·4	586·2

Test No. 4 has been omitted from this table since the vacuum was controlled, an air leak being introduced in order to obtain the special vacuum.

* (t)s is the temperature corresponding to the measured exhaust pressure at the turbine exhaust flange.

† (t^1)s is the temperature measured at the turbine exhaust flange.

‡ The Corporation's specification called for the guarantees of consumption to be based on feed heating conditions as being representative of actual working conditions, and it was for this reason that the majority of tests were based on feed heating.

§ The Corporation's conditions of contract did not specify vacuum, but were drawn up so as to make the consumption guarantees inclusive of the performance of both turbine and condenser. The guarantees were made upon the basis of the condenser being supplied with the contract quantity of cooling water at the specified standard temperature of 83 deg. Fah.

The following table gives a summary of the results obtained, together with the coal cost and works costs, from the beginning of April of this year:—

Period, Twenty-four Weeks from Week Ending April 11th to Week Ending September 19th, 1928 (168 Days).	
Total units generated	54,173,017
Total units on auxiliaries	3,043,200
Total units delivered to feeders	51,129,817
Percentage of units used on works to units generated	5·63 per cent.
Maximum load on plant	26,500 kW
Load factor on units generated	50·70 per cent.
Maximum load on feeders	25,220 kW
Load factor of units delivered to feeders	50·30 per cent.
Average calorific value of fuel as received	11,350 B.Th.U. per lb.
Total weight of coal burnt	36,205 tons
Pounds of coal per unit generated	1·497
Overall thermal efficiency per unit generated	20·20 per cent.
Pounds of coal per unit delivered to feeders	1·585
Overall thermal efficiency per unit delivered to feeders	19·00 per cent.
Coal consumption per unit generated	1·497 lb.
Coal cost per unit generated (including freightage of coal and removal of ashes)	0·1273d.
Total works costs per unit generated (excluding administration)	0·1824d.
Administration	0·0423d.
Total works costs per unit generated	0·2247d.

The table shows that a high standard has been consistently maintained throughout the plant. In the case of the turbo-alternators, the results are, of course, due to the care given to the design and manufacture of both turbines and condensers. In the case of the boiler plant, the high efficiency is, amongst other reasons, due to the high setting of the boiler tubes above the surfaces of the grates, which prevents chilling of the furnace gases before combustion is complete. It has also been due to careful operation and maintenance of the plant which have been facilitated by reason of the attention given in the lay-out of the station.

Such results would constitute just cause for satisfaction in a station deriving its cooling water direct from the river, and when it is considered that the station is an inland one dependent on cooling towers, it will be realised that such an efficiency is extremely satisfactory, and it is questionable whether any other cooling tower station in the country could approach such a high figure. In addition, owing to the care taken in designing the station, it is possible to run it with a very small number of men. The number actively employed in the Lister Drive No. 3 station, including shift engineers, but not including the repair and maintenance staff, is thirty-five, and the station is capable of dealing with a load of 30,000 kW; this works out at 860 kW per man, an extremely high figure. The number of men required when the station is working at 50,000 kW will be fifty, or one man per 1000 kW.

A NEON INDICATOR.

WITH the increasing use of electricity in the home for heating, domestic appliances and supplying high and low-tension current for wireless apparatus, there is a need for some means of indicating whether or not these various appliances are in circuit. Although wasteful, the practice of using a large carbon lamp or a 20-watt vacuum lamp on switch-boards, electric cooking stoves, &c., is still continued, but to obviate this wastage Philips Lamps, Ltd., has introduced a neon indicator. It measures only 55 mm. by 17 mm., and has a very low current consumption, i.e., half a watt. It emits a light which, though subdued, is instantly discernible both in daylight and strong artificial light, but does not throw out heat. One of the electrodes takes the form of a small disc, and the other that of a ring, the small glass cylinder in which they are contained being filled with neon gas, which becomes illuminated when the electrodes are subjected to a difference of potential.

The indicator also constitutes a very useful adjunct to switchboards in use in factories, theatres, and other large buildings having elaborate lighting systems. It is not always possible quickly to ascertain which lamp or group of lamps are alight by the position of the switches, but by equipping the switchboard with neon indicators the operator can gain this information at a glance. The indicators are connected to a special type of auxiliary circuit, and light simultaneously with the lamps or group of lamps in the circuit. Thus it will be seen that if a fuse blows it is possible at once to observe the lamp or lamps affected. The device is of particular value on three-phase motor circuits, for if a fuse were to blow unknown to the operator, the motor would be burnt out. The indicators are made for 100-250 volt alternating-current and for 150-250 volt direct-current, and are fitted with either S.B.C. or S.E.S. caps. For power installations and switchboards a double-ended 400-650 volt indicator is made.

Obituary.

SIR ALEXANDER B. W. KENNEDY.

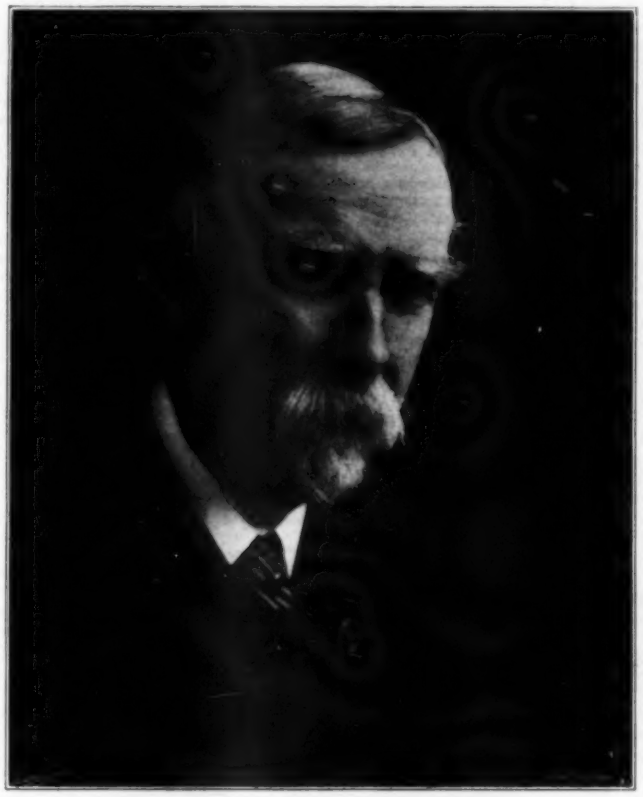
THE engineering profession has been made very sensibly the poorer by the death of Sir Alexander Kennedy, which took place at his home in The Albany, Piccadilly, London, on Thursday, November 1st. By engineers of the present generation Sir Alexander was, perhaps, regarded as simply the successful designer of electric generating stations; but, as a fact, during his long and strenuous life he filled many *rôles*, which covered nearly every branch of engineering, and in all of them he became an expert.

Sir Alexander Blackie William Kennedy was born in Stepney, London, on March 17th, 1847. He was, therefore, well on into his eighty-second year at the time of his death, though there were few who realised that he had reached that advanced age. He was the son of the Rev. John Kennedy, D.D., and his mother—Helen Stodart—was the sister of Professor John Stuart Blackie, who was professor of Greek at Edinburgh University. He received his early education at the City of London School, proceeding from there to the School of Mines, which was then in Jermyn-street. When quite a lad, only seventeen or so, he went as pupil to Messrs. J. and W. Dudgeon, of Millwall, and gained his first experience in marine engine construction. Twin-screw and compound engines were, at that time, just being introduced, and the young man had an opportunity of obtaining a first-hand insight into the design and construction of both. Of that opportunity he took such excellent advantage that, in 1868, after being four years at Millwall, and when only twenty-one years of age, he was made leading draughtsman in Palmers Engine Works at Jarrow, and not very long afterwards was invited to become chief draughtsman to T. M. Tennant and Co., of Leith, which position he held until 1871. By that time he must have achieved exceptional proficiency in the branch of the profession which he had been specially studying, for he was taken into partnership by a Mr. Bennett, a consulting marine engineer of Edinburgh and Glasgow, the title of the firm being Bennett and Kennedy.

In the year 1874 he reached a turning point in his career; he was appointed Professor of Engineering at University College, London. It may seem somewhat surprising that so young a man should have been given such an important and responsible position, particularly having regard to the specialised nature of his previous experience; yet, in view of the success which he achieved in it, it is universally acknowledged that, in selecting him, the elective authorities made a thoroughly good choice. Those who worked with and under him testify that he made an admirable Professor during the fifteen years or so that he held office. One of his outstanding innovations was the foundation of an engineering laboratory at the College. It was the first institution of its kind, and it proved—as indeed he thought that it would—of such great benefit in the training of engineering students that it has been copied throughout the world. In this laboratory he carried out a long series of experiments on the strength and elasticity of materials. While at the College, too, he designed a steel arched pier for Trouville, and the steel and concrete internal structure of the Alhambra Theatre, which is said to have been the first building in which concrete slabs were used on a large scale to carry weights.

Professor Kennedy's connection with the University of London ended in 1889, and thereafter, until two years before his death, he was in practice as a consulting engineer in Westminster, at first with Mr. Bernard Jenkin and, on his retirement, with his son, Mr. J. M. Kennedy, and Mr. S. B. Donkin.

In 1889 the new form of energy—electricity—was just beginning to assert itself. At first it was mainly employed for lighting, though very soon it was used for power and traction purposes, and there were those who foresaw, albeit, perhaps, dimly, the far-reaching influence which it was destined to have on the fortunes and economics of the universe. Kennedy was among them, and he decided to devote his life's work to taking a share in the evolution which he felt sure was bound to take place. That he was not entirely without misgivings in coming to that decision was made quite plain in his presidential address before the Institution of Mechanical Engineers, which was delivered some five years later. After remarking that it was noteworthy in how many cases, especially in that Institution, a man of thirty-five or forty was found to be working with great success in a line totally different from that in which he had gained his first experience, he went on to say:—"He is a wise man who can tell, as each opportunity presents itself, whether it is really a tide to be taken at its flood, or whether it is one in which his swimming powers will not be sufficient to carry him on to fortune, but may only leave him, and those who trust to him, still short of *terra firma* when the ebb commences. The consideration of this point has probably caused many of us more anxious moments than the actual working out of any of the knotty engineering problems which come upon us after the plunge is taken. I speak of the matter from hard enough experience, for I myself have had all too often to decide such questions, sometimes in one sense and sometimes in the other. So it happens that, having served my time with Marine Engineers, I have had in the last twenty-five years to busy myself with half-a-dozen varieties of mechanical and structural work, including what I may call the academic variety during many happy years at University College, and of late years with the newest variety of all—electrical engineering." He need, however, have had no such qualms as those he mentions, for though at first his path may have been strewn with thorns, as his remarks would seem to suggest, he very soon made himself felt as one of the leading authorities in electrical engineering matters. Incidentally, it may be remarked that he was the first electrical engineer to be elected President of the Institution of Mechanical Engineers.



SIR ALEXANDER KENNEDY, F.R.S.

Sir Alexander was connected directly or indirectly with a very large number of electrical undertakings, and may well be described as a pioneer in connection with them. There were but few electric supply stations in this country when he entered the lists, and they were very modest ventures when compared with the super-power stations of the present day, and practically the whole growth of electricity supply to its present huge proportions took place during his professional lifetime. It would be quite impossible, in the space at our disposal, even to give a list of the stations and power plants in which he was interested, much less to refer to them in detail; but included among them were works in London, Glasgow, Edinburgh, Buxton, Ipswich, Stirling, Grimsby, Rotherham, Motherwell, and at Loch Leven, as well as at Calcutta and in Japan. He became engineer to the Westminster Electric Supply Corporation, Ltd., when it was started in 1889, that is to say, in the year that he left University College. A year later he was made engineer to the Central Electric Supply Company, Ltd., and he was also engineer to the St. James' and Pall Mall Electric Light Company, Ltd. He was concerned with two of the London Tube Railways, the Waterloo and City and the Hammersmith and City, and in connection with other railways he was consulting electrical engineer to the old London and North-Western and London and South-Western. He was Consulting Engineer to the London County Council during the construction of the first sections of that body's tramways, and, later, his firm became consulting engineers to the Council for electrical matters in general. Among other positions which he held were those of Consulting Electrical Engineer to the Corporation of Edinburgh and to the Calcutta Electricity Supply Company.

The foregoing does not claim to give anything in the nature of a complete list of Sir Alexander's activities in the domain of electricity supply, but it, at any rate, indicates to some extent their nature and variety.

That he met with success in the branch of his profession which he had chosen specially to follow is amply evidenced by the multiplicity of work that he was called upon to perform. Any success that he had been able to achieve, he was wont to aver, he attributed to the fact that he had become, by training and experience, a practical mechanical engineer before technical electricity existed. He maintained that electrical engineering was merely a variety of mechanical work, and must always be so regarded, and he believed that the only really safe road to success in electrical work lay through the old routine of mechanical training, "modified, of course, by the excellent means for studying the scientific side of the work which now exist in so many directions." Those pronouncements were made in the year 1894, when time enough had elapsed from the commencement of what may be termed "commercial electricity" to show how easy it was for failure to occur when electrical machinery was designed by men who had no adequate mechanical training.

In this connection it may not, perhaps, be out of place to recall some of the remarks made by Dr. (afterwards Sir) William Anderson, who preceded Sir Alexander as President of the Institution of Mechanical Engineers, when seconding the vote of thanks to the latter for his opening address. He said that Professor Kennedy—as he was then still called—was himself an illustration of what a thoroughly trained and educated mechanical engineer could turn his hand to. "Thoroughly well and scientifically educated, he had served his time, as he had told them, in one branch of the profession; he had then further educated himself more thoroughly by educating others, than which he [Dr. Anderson] knew no better plan; and now he was able to take up an entirely new branch of work, as if it were natural to him. A thoroughly educated engineer could turn his hands to anything that came before him, because he had within himself the foundations of engineering science, when he had a grasp of all the sciences which contributed towards it."

Sir Alexander had also been a member of the Institution of Electrical Engineers since 1890, but though he had served on the Council of that society, he never reached the presidential chair.

It not infrequently happens that the busiest of men manage to do a vast amount of work outside what may be termed their own particular professional occupations. Sir Alexander was one of those. In addition to the posts, which he held, that have been referred to above, he was elected an Associate Member of the Ordnance Committee in 1909—in itself an appointment of great distinction, since all the civil members of that Committee have been men of the highest attainments; made Member and Reporter of the Belleville Boiler Committee of the Admiralty in 1900, and subsequently—in 1904—became Chairman of the late Machinery Designs Committee of the Admiralty; appointed a Member of Lord Parker's Committee on Wireless Telegraphy, 1913; chosen as President of Section G of the British Association for its Oxford meeting in 1894—the year of his "Mechanicals" Presidency; created Warden of the Guild of Undergraduates of Birmingham University in 1909; and Chairman of the Advisory Committee on Electric Railways under the Ministry of Transport, 1920. He published, in 1876, a translation of Reuleaux's "Kinematik;" "The Mechanics of Machinery," in 1886; Moore's "Alps in 1864;" and "Ypres to Verdun," in 1921. The translation of Reuleaux's work enjoyed a high reputation, which it fully merited both by reason of the excellence of the translation and also of the profound knowledge with which the subject was handled.

I

It falls to few to be Presidents of our two premier engineering institutions, yet Sir Alexander had that honour. We have already referred to his presidency of the "Mechanicals;" he was also elected President of the "Civils" in November, 1906. In opening his presidential address he again referred to the fact that he had worked in many branches of engineering—from marine to academic, from constructional to electrical—and that, having spent his forty years of business life "in so many different wildernesses," he could not reasonably claim to know the ways of any one of them as thoroughly as his more judicious predecessors had known their particular regions, nor could he take up the position regarding any one of them which had been rightly taken by former Presidents. He did not, therefore, propose, he said, to discuss any of the branches of engineering with which he had been connected—as was customary for Presidents of the Institution to do—but to take the "man" as his subject, rather than his "work." The result was a most eloquent address on "Engineering and Modern Life," the subject being divided under the following headings:—"Science," "Art," "Nature: Water Power, Mountain Railways," "Law: Specifications," "Commercial and Professional Life," "Industrial Life," "Mechanical Evolution."

As was to be expected, advantage was taken, during the war period, of Sir Alexander's knowledge and experience. He served on the panel of the Munitions Inventions Department; acted as Chairman of the Committee on Gun-sights and Range-finders, and as Vice-Chairman of the Committee on Ordnance and Ammunition and of the Anti-aircraft Equipment Committee. As was to be expected, too, Sir Alexander had many distinctions conferred upon him. He was elected a Fellow of the Royal Society in 1887, and received his knighthood in 1905. He was also honorary LL.D. of the Universities of both Glasgow and Birmingham, and honorary D.Eng. of Liverpool University; Hon. F.R.S. Edinburgh, and Hon. F.R.S. New South Wales. He was also created a Pasha by King Hussein in 1924. An honour which he valued very highly indeed was that of being made an Honorary Member of the Institution of Civil Engineers in April of this year.

When he had already passed the allotted span of human life by five years he undertook the laborious task of carrying out an exploration of Petra and, as a result, published at the end of 1925, a monograph entitled "Petra: Its History and Monuments." It, as was his "Ypres to Verdun," which was published in 1921, was illustrated by excellent photographs taken by himself. He was, it may be explained, an accomplished photographer and had been President of the Camera Club. He was also a practised mountaineer, and was long a member of the Alpine Club. It was, indeed, his keenness for Alpine climbing that led him to edit Moore's "Alps in 1864." Among his recreations were music and golf, and, on its formation in 1907, he was made President of the Engineering Golfing Society, a position which he continued to hold until his death.

As regards Sir Alexander—the man—the testimony of those who worked for him is that there could not possibly have been a better chief. Two of his great characteristics were: first, his power of at once grasping the really essential details of anything; and secondly, his ability to express himself accurately. He was often known to dictate a lengthy report without a single hesitation, and when that report was typed not to have to alter a single word in it.

SIR WILLIAM COLLINGWOOD.

We have to record with regret the death of Sir William Collingwood, K.B.E., at his home, Dedham Grove, near Colchester. Sir William was best known in Lancashire on account of his long connection as general manager and managing director of the Vulcan Foundry, Newton-le-Willows. He received his early training at Stratford, London, E., where he was an apprentice at the Great Eastern Locomotive Works, and later he was employed for about twelve years as District Locomotive Superintendent on the East Indian Railway. It was in 1892 that he was appointed general manager at Newton-le-Willows, and he continued to hold that post until 1912, when he was given a seat on the board of the company, and was appointed managing director.

Sir William was a keen man of business with a peculiar organising ability, and he used it to good effect at the Vulcan Foundry, which enjoys a high reputation for up-to-date workshop methods and machine tool practice. It was largely due to him that these works were brought to such a high position in the locomotive building world.

Besides carrying on his own duties in engineering, Sir William played an active part in public affairs and for many years served as a member of the Lancashire County Council. He was elected President of the Manchester Engineering Employers' Federation in 1913 and was a member of the Engineering Standards Committee. During the war he identified himself very keenly with the Manchester and District Armaments Output Committee, of which he was Chairman. He was created a Knight of the British Empire in 1917.

GEORGE BOYD.

The death occurred on Monday evening, November 5th, at his home in Whitehaven, Cumberland, of Mr. George Boyd, at the advanced age of ninety-three.

Mr. Boyd, who was born at Brough-by-Sands, near Carlisle, acquired his early experience in connection with the de-watering of the Carlisle Ship Canal and the construction in its place of a railway from Carlisle to Port Carlisle and Silloth. He was also concerned with the construction of the first Silloth Dock and the Elizabeth Dock, Maryport, as well as with the first Carlisle Waterworks. He was afterwards engaged in railway construction work in Lancashire, Yorkshire, Durham, Westmorland and Cumberland as resident engineer, principally under the late Sir Thomas Bouch.

In 1867 Mr. Boyd went to Whitehaven on his appointment as engineer to the old Whitehaven, Cleator and Egremont Railway, an appointment which was terminated in the early 'eighties by the acquisition of that railway by the L. and N.W. and Furness Railway Companies jointly. For the Cleator Company he carried out as engineer new railway extensions and widenings. Subsequently he started practising on his own account, and as railway construction had considerably decreased he took up local government work and was responsible for the carrying out of numerous works of water supply, sewerings, &c., for the Egremont, Arlecdon, Frizington and other local authorities. Later he was appointed engineer and surveyor to the Whitehaven Rural District Council and carried out in its district a number of water and sewerage works and road improvements.

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

A CONDENSER PUZZLE.

Sir,—Your leading article "A Condenser Puzzle" is a valuable and clear statement of the present position, but I venture to suggest that the conclusions are wrong.

Those conclusions in a condensed form appear to be: (1) There is probably no condenser capable of giving a condensate with a temperature higher than the temperature of the exhaust steam at the inlet flange; (2) that if such a condition exists in any condenser, valuable and complicated apparatus would be required to demonstrate it; (3) that when proved, it would require a new law to explain it, as no known law is capable of doing so.

On the contrary, (1) there are probably numerous condensers in existence capable of exhibiting the phenomenon under suitable conditions; (2) it is easily demonstrated with three thermometers stuck in the right places; (3) well-known laws are quite capable of explaining it.

Referring to some test figures before me at the moment, the temperature measured at A—see Fig. 1—is 71·7 deg.

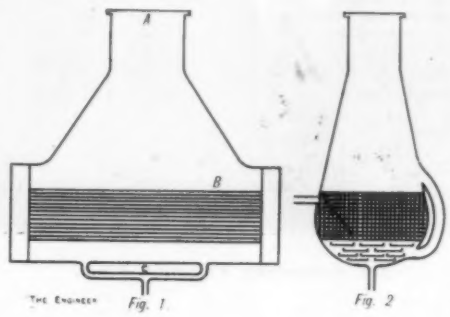


Fig. 1

Fig. 2

Fah. and at C 73·55 deg. Fah. This would have been remarkable had the temperature at B been 71·7 deg. Fah., as at A, but the temperature measured at B was actually 76·2 deg. Fah., 4½ deg. Fah. higher than at A.

Whereas in your leader you assume an entering steam velocity of only 200ft. per second, in the above example a rough calculation gave an entering velocity of 440ft. per second at point A.

Again, you assume that the kinetic energy in this steam is only available for heating up the condensate by direct impact, whereas, in the case cited above, between the points A and B there is a loss in velocity of about 340ft. per second—assuming the velocity at point B to have fallen to about 100ft. per second—which loss represents a gain of 3·7 B.Th.U. per pound at B, which would raise the temperature of the mixture, consisting of 90 per cent. steam and 10 per cent. water particles, about 6 deg. Fah. This appears to confirm the actual measured rise of 4½ deg. Fah. between A and B. The drop of temperature between B and C probably no one would quarrel with, but suppose this condenser had been provided with drip trays, as shown in Fig. 2, and an external by-pass across the tubes or its internal equivalent, is it not extremely probable that the temperature of the condensate would have been 76 deg. Fah., *i.e.*, over 4 deg. higher than the temperature of the exhaust steam at the inlet flange?

There is little doubt that a condenser could be designed so that when the turbine was running on heavy load and the circulating water was very cold, the condensate temperature would be 10 deg. Fah. higher than the temperature of the steam at the entry. Such a condenser would be of great size and of doubtful commercial value, but the statement is provided as a juicy morsel for the sceptics.

F. C. Sellens.

Barking, Essex, November 6th.

THE COMPRESSED AIR BRAKE.

Sir,—With reference to your remarks on the origin of the continuous air brake—*vide* your issue for October 12th, page 408, under the heading "Sixty Years Ago"—it is of interest to recall that the late Mr. A. R. Bennett, in a letter which you published on March 27th, 1914, drew attention to the fact that a continuous air brake system had been invented as long ago as the year 1851.

Mr. Bennett stated that he possessed a volume entitled the *Expositor*, a publication which appeared during the run of the Exhibition of 1851, and that this publication contained a communication, signed "An Operative," describing and illustrating an air brake which, although somewhat crude, had most of the essential features of the Westinghouse brake, as devised by the late Mr. George Westinghouse in 1868.

The real name of the writer of the communication in question remains, I believe, unknown. Assuming that "An Operative" was not Charles Kendall, his continuous compressed air brake system would thus appear to have ante-dated Kendall's, as used in 1864–8 on the L.C. and D.R.'s metropolitan section, by twelve years or so. In some respects, the two systems were not greatly dissimilar. In Kendall's arrangement the air pump was driven by straps on one of the carriage axles; in the system proposed by "An Operative," an excentric, also on one of the carriage axles, was employed to work the pump. Flexible connections were used in both systems, and both brakes were applied by the guard by means of a cock, although it was subsequently intended, as stated in your notes, to place the control of Kendall's brake in charge of the driver.

It may be, of course, that George Westinghouse evolved his own brake independently of anything that had previously been done in the same direction in this country. He at first thought of employing steam, but gave up this idea as impracticable, owing to the impossibility of preventing condensation taking place in the train pipe. According to his own story, the adoption of compressed air instead of steam occurred to him as a result of reading in a monthly paper of the successful operation of machinery by this form of air power for the purpose of boring the Mont Cenis Tunnel.

The fact remains, nevertheless, that a workable compressed air continuous brake had been invented here about seventeen years before George Westinghouse had completed his first demonstration apparatus; moreover, a brake of the same kind in principle, if not in detail, had been in use in England on the old L.C. and D.R. from approximately 1864, and had given great satisfaction.

On the other hand, Westinghouse's scheme was perhaps of a slightly more mature character, and the adoption of a steam-driven air pump on the engine, and the placing of the operation of the brake in the hands of the driver, were two points of no little importance.

According to Mr. Bennett, the brake designed by "An Operative" in 1851 was never taken up, not because it was impracticable, but because of the apathy of railway officialdom at that time in regard to anything so new and startling as the stopping of trains by the aid of compressed air.

F. W. Brewer.

Stevenage, Herts., October 22nd.

COBDEN BRIDGE, SOUTHAMPTON.

Sir,—In your descriptive article of the above work published last week, I regret to see that the name of the engineer is mis-spelt and his qualifications incorrectly described.

Surnames having the prefix "Fitz" are not spelt with hyphens; but, more important, the qualification was stated as Assoc. M. Inst. C.E., whereas it should have been M. Inst. C.E.

As engineer for this work I feel it necessary to call your attention to these errors.

H. W. Fitz Simons, B.Sc. (Eng.), M. Inst. C.E.

Westminster, S.W., November 7th.

Electrification in rural districts was discussed at a special committee meeting of the Wellington branch of the National Farmers' Union held at Wellington recently. The West Midlands Joint Electricity Authority's scheme was fully explained by Mr. E. F. Hetherington, chief engineer and manager, who said that in 1927 there were 1770 farms connected to public supply mains in rural areas in Great Britain, and they did not make any substantial use of electrical power for various processes associated with farming. The supplies were used chiefly for lighting, heating and domestic purposes in the farm-houses. It was only by a more extended use of electrical energy for all purposes that supplies would be cheapened. Mr. Hetherington spoke of the uses to which electricity might be put on a farm. Provided a cheap supply of electrical energy were available they might look for a considerable demand for electricity for such purposes as crop drying, thrashing on smaller farms by travelling electrical equipment; milking, where a sufficient head of stock was kept to justify the cost; poultry keeping and egg production; and the electrical heating of soil in frames for crop growing and horticultural purposes. He pointed out that the authority's undertaking was not a profit-making scheme, and the greater the demand the cheaper the supply would be.

Triple and Quadruple Expansion Steam Engines.

The presidential address of Mr. Maurice S. Gibb, delivered on October 19th before the opening meeting of the North-East Coast Institution of Engineers and Shipbuilders, was appropriately devoted to an historical review of the use of triple and quadruple-expansion steam engines for marine propulsion. During the evening Professor Weighton was made an honorary fellow of the Institution in recognition of his work on the reciprocating marine steam engine, and the Engineering Gold Medal of the Institution was awarded to Mr. S. G. Visher for his paper on "The Application of High Pressures to the Reciprocating Marine Steam Engine." In what follows a short abstract of Mr. Maurice Gibb's address is given.

Triple-expansion Engines.

The triple-expansion engine for marine propulsion was introduced by J. Ferguson in 1872, who designed a small engine of that kind which was installed in the launch "Mary Ann." Ferguson was followed by A. C. Franklin, who in 1873 designed the engine for the "Sexta;" by A. C. Kirk, who designed the triple-expansion engines for the "Propontis," built in 1874, and by Alexander Taylor, in 1876, with the engines for the yacht "Isa."

From 1883 onwards the triple-expansion engine working on three cranks became the normal type for the mercantile marine for powers up to about 3500 I.H.P., but many triple-expansion engines for larger powers were built during that period. With the introduction of mild steel for the manufacture of boilers the steam pressure was gradually advanced from 125 lb. in 1881 until 180 lb. per square inch was reached, and this is the most common pressure for triple-expansion engines to-day, although there are many installations working at 200 lb., some at 220 lb., a few at 230 lb., and one, which I shall refer to later, at 500 lb. per square inch.

Although during the last forty-five years there has been little change in the principles of the design of the three-crank triple-expansion engine, with the exception of that due to the increased steam pressure, there have been many improvements made in detail. The principal modification, however, in recent years has perhaps been the reduction in the size and weight of the engines for the same power, which has resulted in increased engine revolutions and higher mean referred pressures being used.

Professor Weighton's investigations on the marine engine have been published in the "Transactions" of the Institution. Those first published (1896) gave, for the reciprocating engine data possibly of as great practical utility as any offered since the virtues of expansion of steam were made known. The results did not meet with general acceptance at the time, because they did not agree with the theories held by most contemporary marine engineers. Most designers, manufacturers and consultants still held the view that, in a multiple-expansion reciprocating engine, the best result must be obtained by carrying expansion down to the condenser pressure, if possible.

Professor Weighton did not share this view, and his experiments proved him to be correct. Although very few engineers accepted or adopted his proposals at the time, by 1919 understanding had advanced sufficiently to enable a mean effective pressure of 32·8 lb. per square inch—referred to low-pressure cylinder—to be selected for the North-East Coast Institution specification for triple-expansion engines, compared with about 27 lb. which was generally considered good practice at the time of Professor Weighton's experiments.

Enlightened engineers have since then moved even nearer to the ratio of expansion recommended by him, and within the last few years several quadruple-expansion sets, in which the results have been pretty fully applied, have surprised both builders and owners by their economical performance, measured in terms of economical propulsion.

Modifications of Triple Engines.

Turning now to some modifications of the triple-expansion engine, of which there are many, I mention only a few examples, most of which have come within my personal knowledge.

Three-crank Compound.—Although not actually a triple-expansion engine, a large three-crank compound engine, which was built as long ago as 1881, might be called a modification of the triple. As steam pressures increased this type of engine was superseded by the more efficient three-crank triple-expansion engine.

Five-crank Quadruples.—About 1894 the late Thomas Mudd designed a five-crank quadruple engine in which he applied the device, already well tried in compound and triple-expansion engines, of dividing the steam in the last stage of expansion between two low-pressure cylinders. Superheat and the remarkably high pressure at that time in cylindrical boilers of 255 lb. per square inch were carried. The first ship in which the installation was fitted was the "Inchmona," which traversed the seas with the original boilers at the original pressure from 1896 until 1924, when the vessel was broken up, after a useful life of twenty-eight years.

Mr. Mudd died during the first year or two of the sea service of the "Inchmona," but about the time of his death the owners of the "Inchmona"—whose superintendent, the late Mr. C. Edmiston, of Liverpool, was a strong advocate of the system—placed an order for an improved set of practically the same engine dimensions, but with a higher pressure, namely, 260 lb. per square inch—again with cylindrical boilers. Three other sets followed with still higher steam pressures of 267 lb. and 268 lb. per square inch.

The temperature of the air in these five-crank installations after leaving the air heater on its way to the furnaces was comparatively high—about 350 deg. Fah.—in fact, much higher than contemporary marine practice, which was between 170 deg. Fah. and 200 deg. Fah. Little attention has been paid to heating the air to higher temperatures since that time until recently, but, with the more general adoption of higher steam pressures, attention is being given to the design of air heaters in order to absorb more of the heat coming from the boilers. These five-crank installations worked in service at mean referred pressures varying between 24·8 lb. and 31·5 lb. per square inch, and fuel consumption of 1·15 lb. to 1·24 lb. of coal per I.H.P. hour for all purposes was obtained.

High-pressure Four-crank Quadruples.—Many four-crank quadruple-expansion engines working with a steam pressure of about 220 lb. per square inch have been built during the last thirty years. Within the last three or four years a number of quadruple-expansion installations of this type have been made with steam pressures up to 265 lb. per square inch, and the particulars of these installations given in the table below may be of interest in view of the present-day tendency to adopt higher steam pressures and greater mean referred pressures. It will be noticed that these mean referred pressures are in marked contrast to the earlier installations mentioned.

High-pressure Four-crank Quadruples.

Steamer.	Steam pressure.	Service I.H.P.	Revs. per minute.	Mean ref. pressure.	Coal, lb. per I.H.P. per hour for all purposes.	Temp. of heated air to furnaces.	Superheat.
	lb. per q. in.			lb. per sq. in.		Deg. Fah.	
"City of Bedford"	250	3500	80	39·5	1·25	250	None
"City of Delhi"	250	3500	80	39·5	1·25	250	None
"City of Bath"	260	3000	82	44	1·25	275	None
"City of Canberra"	265	4500	81	42	1·23	320	150° F.
"Rio Diamante"	260	1800	65	39	1·21	300	150° F.

As steam pressures have increased the trend in design of marine reciprocating engines in the search for greater economy has been towards more cylinders and a greater number of cranks per engine. Mr. Visker, however, struck out on a line of his own and applied a steam pressure of 500 lb. per square inch to a three-crank triple-expansion engine in the ss. "Borneo." This bold and interesting experiment is described in the paper which he read before the Institution last session entitled "The Application of High Pressures to the Reciprocating Marine Steam Engine."

Mr. Gibb made a short reference in the later part of his paper to marine steam turbine and marine oil engine progress. He referred to the introduction of the combined reciprocating engine and exhaust steam turbine arrangement and said that a further modification of this system was now being made by the combination of a high-pressure four-crank quadruple-expansion engine and a low-pressure turbine of a total power equivalent to 6300 I.H.P. This installation, which is to work at a steam pressure of 255 lb. per square inch, is expected to be ready for service early next year.

London Water Supply.

Some interesting particulars regarding the water supply in the London area are given in the twenty-fifth annual report of the Metropolitan Water Board for the year 1927–28.

The quantity of water supplied in million gallons during the year ended March 31st, 1928, was as follows:—

	Direct area.	In bulk.	Grand total.
Total volume, million gallons	96,875·4	676·4	97,551·8
Daily average, million gallons	264·60	1·85	266·54

The total daily average supply was 7·04 million gallons more than in the preceding year. During the month of maximum supply (May) the Board supplied a daily average of 277·57 million gallons, the daily average supply per head being 36·54 gallons, which represented an increase of 0·34 gallon compared with the year 1926–27.

The total estimated population supplied by the Board at March 31st, 1928, exclusive of bulk supplies, was 7,303,403, representing an increase of 137,387 during the year, or an amount equivalent to the total population of a town the size of Derby or Wolverhampton. Of this increase 64,084 occurred in the area north of the Thames and 73,303 south of the Thames. Of the total, 4,634,612, or 63 per cent., reside in the area north of the Thames and 2,668,791, or 37 per cent., south of the Thames. The number of services at March 31st, 1928, was 1,219,634, an increase of 19,829 during the year. The addition during the year to the number of inhabited buildings supplied was 23,193.

The amount of storage and subsidence reservoir capacity for unfiltered water possessed by the Board at the end of the year was as follows:—

	No.	Area in acres.	Capacity in million gallons.
Thames Valley ..	32	1,749·5	14,017·5
Lee Valley	17	955·0	5,639·5
	49	2,704·5	19,657·0

According to the supply of 1927–28 the number of days' storage is 73·8 for the grand total supply—including bulk supplies. Water was drawn for the first time from the Queen Mary Reservoir at Littleton, for the purposes of supply, on July 7th, 1927. The total quantity taken from the reservoir during the year was 10,452 million gallons. The coal, coke, oil and electricity consumed during the year for the purposes of the water supply was the equivalent of some 185,000 tons of coal, which was nearly 7000 tons less than the consumption in the preceding year.

In May, 1927, the Board accepted the tender of Wm. Moss and Sons, Ltd., of £55,678 for the construction of primary filters and other contingent works; and the tender of the same firm of £39,323 for the laying of 60in., 54in., 48in., 42in., and 36in. mains, together with contingent works at the Kempton Park station. This company is carrying out the extension of the Kempton Park pumping station, the contract price for which amounts to £152,422. In addition to the amount of the accepted tender, expenditure of £25,175 will be incurred for the installation of rapid filters by the Paterson Engineering Company, machinery, pipes, valves, Venturi meters, steel air compressor tanks, &c., supervision and sundry items. The total cost of this installation of primary filters should be approximately £81,000. The cost of pipes, valves, stores, &c., which are supplied by the Board, also superintendence and the restoration of the surface of the Hanworth-Sunbury road, amounts to approximately £28,000. The total cost of the main laying should be approximately £68,000.

A tender of £74,843 has been accepted by the Board for the construction of an important new covered service reservoir at Bishop's Wood, Highgate, and other contingent works. The cost of pipes, valves, stores, &c., and also of superintendence bring the estimated cost up to £78,816. The work was commenced in January of this year, and it is due to be completed by October of 1929. The work now being carried out is the first section of the reservoir authorised by the Board's Various Powers Act of 1921, and will have a capacity of 22½ million gallons. The reservoir is part of a comprehensive scheme for the improvement of the supply to the north of the Thames. In connection therewith the Board has decided to proceed with a number of new aqueducts of the first importance, including Aqueduct No. 1, being a 48in. main from Cricklewood to Bishop's Wood Reservoir, and a 42in. main from that point to Fortis Green Reservoir; Aqueduct No. 2, being a 48in. main from Aqueduct No. 1 to Bishop's Wood Reservoir; and Aqueduct No. 3, consisting of a 12in. scour main from the reservoir. A tender of £42,532 has been accepted by the Board for laying Aqueduct No. 1 from St. Michael's-road, Willesden, to the Fortis Green Reservoir and Aqueducts 2 and 3. This sum is exclusive of the cost of pipes, valves, &c., restoration of road surfaces and superintendence amounting to £61,741. The total estimated cost is therefore £104,273.

In June of last year the Board decided to remodel the works at Deptford in order to provide for an extended supply to the inner area of the Kent district in the near future and so to permit of the outlying wells, now partly supplying this inner area, to be more largely utilised in their more immediate areas. The total estimated cost of the approved scheme for machinery, buildings, wells, headings and working out mains is £221,000. Under the scheme a triple-expansion engine will pump from one new well connected with the three existing wells by adits. The remainder of the supply is Thames water.

A tender was accepted in March last for the manufacture, delivery and erection of one triple-expansion engine with reciprocating pumps; three steam turbines with centrifugal pumps—with Belliss and Morcom's turbines; and one water-driven turbine with centrifugal pump for £59,348. All the units will be concentrated in one engine-house and the proposed arrangement combines the high efficiency and reliability of the reciprocating unit with the low cost of the turbine sets. In connection with the proposals the Board has also approved estimates amounting to £30,250 for main laying.

Having regard to the condition of the machinery, and in order to increase the efficiency of the Woodford station for the improvement of the supply to the populous districts of Walthamstow, Woodford, Leyton, Ilford, West Ham and East Ham and the growing districts of Chingford and Chigwell, the Board has approved an estimate for the provision and erection of three oil engines driving reciprocating pumps, each capable of pumping two million gallons per day to High Beech and Buckhurst Hill reservoirs. All three engines will be identical in design and interchangeable, two engines being at work and one acting as a standby. The new machinery will be housed in the existing engine and boiler-houses after certain adaptations, the new engines being installed without interrupting the supply from this station. The approved estimate of £35,000 includes oil storage tanks, connections to mains, and alterations to existing buildings, and it is not unreasonable to anticipate an initial saving in working expenses of £1000 per annum with the new plant, increasing in amount with increased demands. An estimate of £23,000 has also been approved for laying approximately 4500 yards of 20in. main between Woodford pumping station and the high road near Buckhurst Hill Reservoir.

The Board has authorised expenditure not exceeding £9500 in (*a*) the purchase and installation at the Hampton works of two new electrical generators with motors, cables, &c., and the replacement of two engines by electrically driven pumps—£9000—and (*b*) the replacement of certain of the pumps at the Sunnyside engine-house by electrically driven pumps—£500. A tender has been accepted for the manufacture, delivery and fixing of two 150-kW steam-driven electric generators.

The arrangements for washing the filter sand from certain filter beds at Hampton have been considered. Economy can be secured by efficient sand washing apparatus with the latest type of hopper washers and ejector hoppers for dealing with the sand. Expenditure of £6000 has accordingly been approved for providing and fixing the apparatus, provision and installation of booster pumps, main laying, &c.

Tired of the careless manner in which Press and public allude to "super power" in broadcasting stations, Mr. O. H. Caldwell, of the United States Federal Radio Commission, suggests rating all stations according to their horse-power. This system, he contends, would give uninformed people a truer conception of the comparatively small power used by even big stations. "Sixty-five horse-power stations like EAF and KDKA, both 50-kW transmitters," he explains, "are not really formidable when compared with a seven-passenger automobile which consumes almost exactly the same amount of power."

The Maentwrog Generating Station and Electricity Supply in North Wales.

No. IV. (*Conclusion*).*

In this, the concluding article of this series, we propose to give some account of the transmission lines radiating from the Maentwrog and the other generating stations, and also from the sub-stations of the North Wales Power Company, Ltd.

First, however, it will perhaps not be out of place briefly to discuss the company's activities, and the progress which it has made since it began to distribute current. Prior to the year 1925 the only generating station in operation was that at Cwm Dyli, Beddgelert, which, it will be remembered, had at first a capacity of only 4000 kW in four units of 1000 kW each. A further unit, of 1500 kW capacity, was added in 1923. The company's area of supply at first only included the counties of Carnarvon, Merioneth, and Anglesey and part of Denbighshire. The larger consumers of energy were principally slate and granite quarries in the neighbourhoods of Bethesda, Blaenau Festiniog, Carnarvon, Llanberis, Nantlle and Penmaenmawr, while Marconi's Wireless Telegraph Company, Ltd., at Carnarvon, was also a consumer. By the year 1918 the annual sales of energy had only reached some six million units. The progress in supply since that date is shown in the curve—Fig. 8. There was, in 1919, a fall as compared with 1918, but by 1922 the sales had risen to just over eight million units per annum, and thereafter they rose with increasing rapidity until, during last year, they had reached some thirty-eight million units. It is fully anticipated that the same rate of expansion will continue for some years. The Dolgarrog Station of the Aluminium Corporation, Ltd., which has a capacity of 10,000 kW, was put into service in 1925, and now the Maentwrog Station, with an installed capacity of 18,000 kW—22,500 kVA—has been added, while, in addition, a bulk supply can be drawn from the Perceval-lane Generating Station at Runcorn, of the Mersey Power Company. The North Wales Power Company is, therefore, now in a position to meet very much heavier demands than it had, up till recently, been able to satisfy.

During the last few years substantial progress has been made in providing supplies to towns and villages in North Wales and South Cheshire through the activities of an associated company—Electricity Distribution of North Wales and District, Ltd.—formed for the purpose of carrying out and operating electricity distribution schemes in districts not already provided for. Supplies are taken from the power company's system in bulk for the various developments, and, at the present time, thirty-two such points of supply are in service. The power company is now supplying power in bulk to authorised undertakers in some fifty towns and villages, including Abergele, Bangor, Bethesda, Carnarvon, Colwyn Bay, Conway, Crewe, Denbigh, Llanberis, Llandudno, Llanfairfechan, Mold, Nantwich, Oswestry, Penmaenmawr, Portmadoc, Prestatyn, Rhyl, Ruabon, Sandbach, and Wrexham. The principal industries taking energy are slate, granite and limestone quarries in the west and collieries and engineering works in the east. The first group of industries absorbed 29·8 per cent., and the second group 30·85 per cent. of the total energy supplied by the power company's system during 1927. We understand that the highest simultaneous maximum demand on the system that has so far been experienced is 13,300 kW. The area of supply included in the North Wales and South Cheshire Electricity District—over which the power company has to supply current—is shown practically in its entirety, in Fig. 7. Portions of Montgomeryshire and Cardiganshire, to the south, have been omitted from our engraving. It will be observed that this area is very much larger than that included in the company's original scheme. The plan shows the company's network of transmission lines, as well as the generating stations and sub-stations as they exist at present. The different voltages of the various transmission circuits, which we shall now proceed to discuss, are indicated by distinctive markings. It will be observed that whereas the northern portion of the area—especially the coastal districts—are well served, the southern portion has yet to be dealt with.

Prior to the year 1922 the transmission system of the company consisted of about 80 miles of overhead lines in the neighbourhood of Cwm Dyli and Dolgarrog. The pressures principally used were

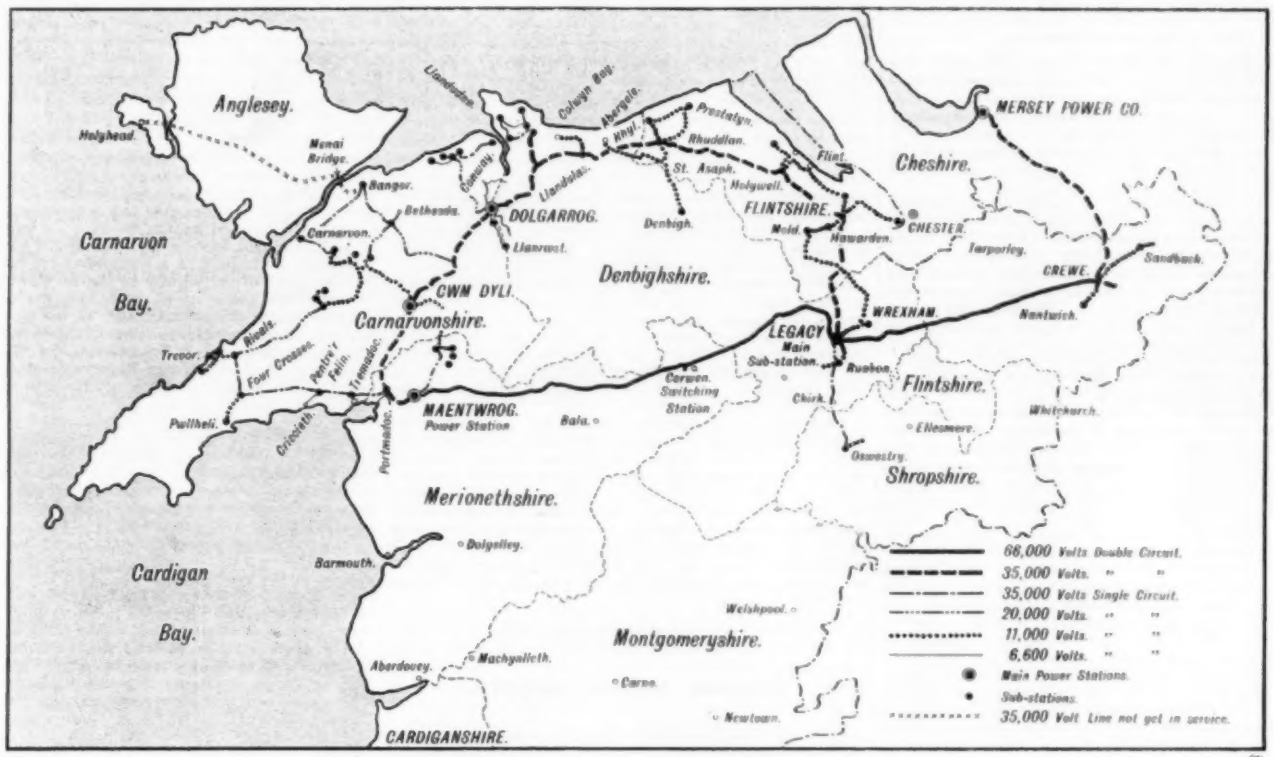


FIG. 7—TRANSMISSION NETWORK OF THE NORTH WALES POWER COMPANY, LTD.

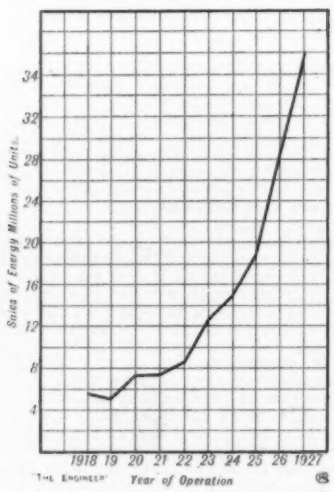


FIG. 8—PROGRESS IN ELECTRICITY SUPPLY

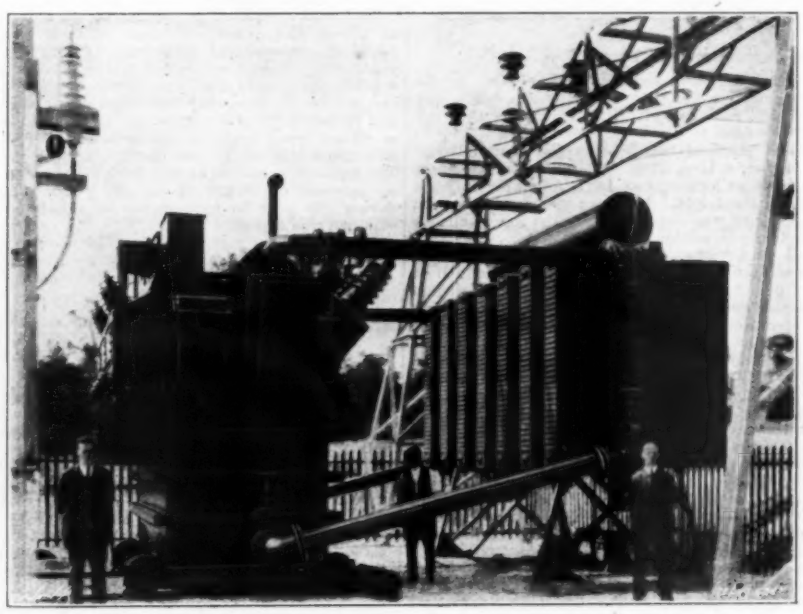


FIG. 9—7500 kVA ON-LOAD TAP-CHANGING TRANSFORMER WITH SEPARATE COOLER

* No. III. appeared November 2nd.

10,000 and 6600 volts with a few lines at 20,000. The developments since that date, however, have involved the transmission of large quantities of power over considerable distances, and a higher series of voltages has, in consequence, had to be employed. During the last six years 95 miles of 66,000-volt, 115 miles of 35,000-volt, and 75 miles of 11,000-volt mains have been constructed. Practically all of these circuits consist of overhead lines, as cable is only used at points of entry into sub-stations, or where wayleave difficulties have been met with owing to the presence of buildings.

An interesting feature of the transmission network is the length of some of the feeders. From Four Crosses sub-station, near Pwllheli, in the west, to Runcorn in the east, *vid* Maentwrog, Legacy and Crewe, measured along the transmission lines, is 115 miles. The load of the London, Midland and Scottish Railway Company's shops at Crewe is normally transmitted from Maentwrog, 70 miles distant, and we understand that power has been exchanged between Maentwrog and the Mersey Power Company, a distance of 95 miles.

For the different transmission lines various types of construction, depending on the importance of the lines, and on the nature of the country traversed, have been used. In the 66,000-volt section connecting Maentwrog and Runcorn three different types have been employed. The first portion of the interconnector is between Maentwrog and Legacy, near Wrexham, a distance of 45 miles. It is a double-circuit line of lattice steel tower construction with normal spans of 650ft., specially designed towers being used at road crossing, angle and section points. Three different patterns of towers are illustrated in Figs. 14, 15 and 16, p. 518. The first shows a normal intermediate tower, while Fig. 15 represents an anchor tower and Fig. 16 a transposition tower, at which the conductors of the two circuits are transposed in order to meet the requirements of the Post Office authorities. We are informed that, actually, there has been very little interference with the Post Office's wires as a consequence of the power company's operations. It may here be mentioned that where Post Office overhead lines are crossed, in many cases the Post Office authorities have insisted on the provision of elaborate cradles beneath the transmission line conductors.

The conductors used on this portion of the network are of steel core aluminium, with a conductivity equivalent to 0·125 square inch of copper, each consisting of a steel core, made up of seven 0·0785in. diameter wires stranded, surrounded by twenty-six 0·10in. diameter aluminium wires. The insulators, which, as will be observed in the illustrations, are of the suspension type, comprise four discs in series on intermediate towers, and five discs in series at road crossings, section towers, and at other points at which special protection is required. To facilitate maintenance an outdoor switching station, which is illustrated in Fig. 17, has been erected at Corwen. It provides for the complete control of both circuits in both directions. The conductors are terminated on galvanised steel structures, on which air break isolating switches are fitted to each circuit. In addition, cross connections fitted with similar switches are provided and provision is made for a tapping to be taken off if a local supply through a transformer has to be given in the future.

The 66,000-volt line between Legacy and Crewe is carried on narrow-base steel towers and has copper conductors of 0·10 square inch cross-sectional area. In this portion of the line the normal span is 360ft., and pin insulators are used. Copper conductors of 0·10 square inch section and pin insulators are also used for the line between Crewe and Runcorn, which is carried on wood poles of the "A" type, with a normal span of 300ft. Only one circuit of this line is insulated for 66,000 volts. At present only the line from Maentwrog to Legacy is operated at 66,000 volts, the remainder being run at 35,000 volts. The Maentwrog–Legacy line, which has, as has been said, a length of 45 miles, is the longest transmission line in the system, and was built by Siemens Brothers, Ltd., Woolwich, the lines from Legacy to Runcorn, *vid* Crewe, being erected by the Foundation Company, Ltd., London.

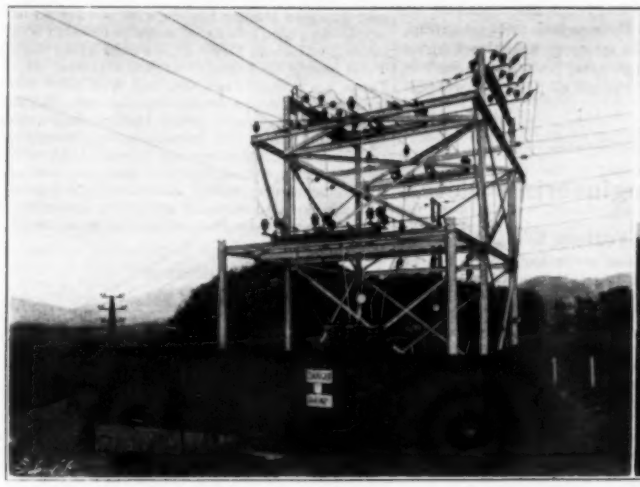


FIG. 10—LLANFROTHEN OUT-DOOR SUB-STATION

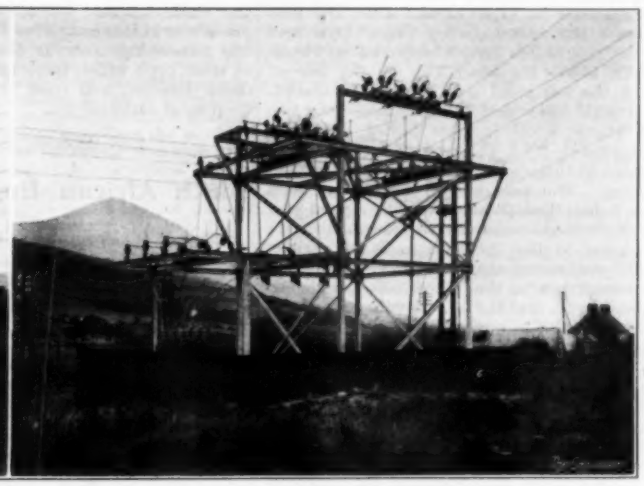


FIG. 11—RIVALS OUT-DOOR SUB-STATION

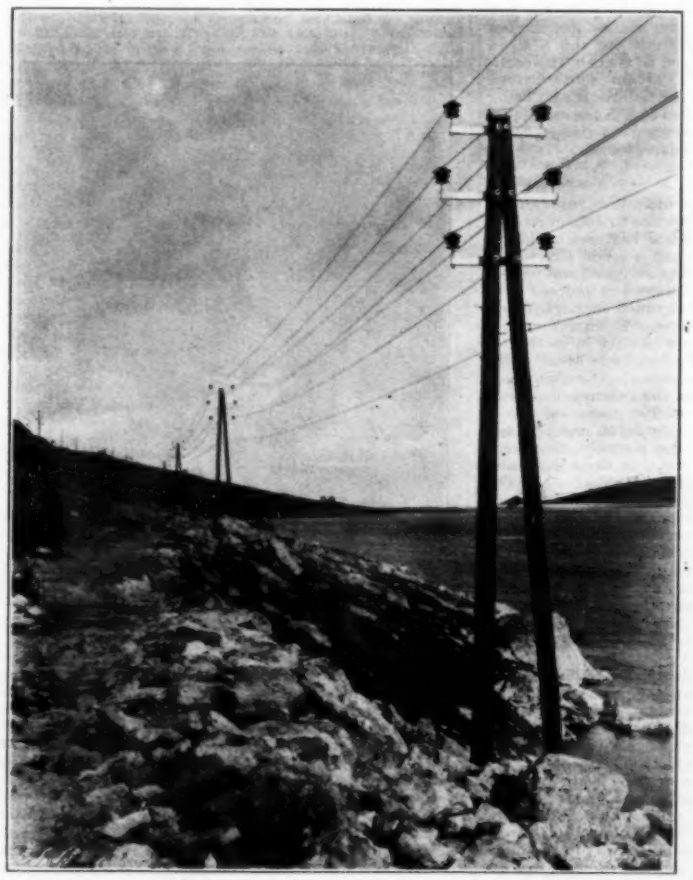


FIG. 12—35,000 VOLT LINE BETWEEN CWM DYLI AND DOLGARROG

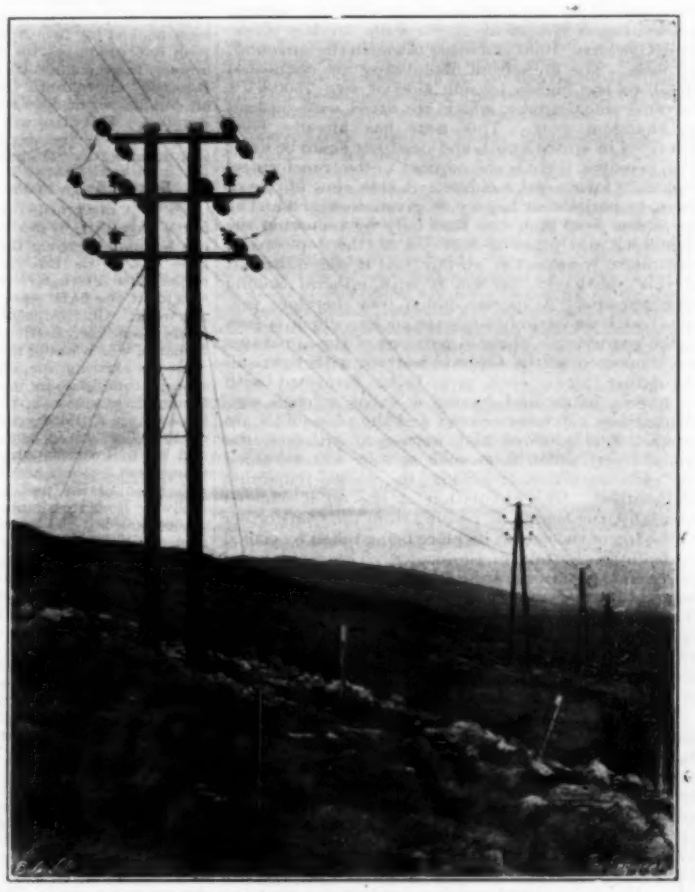


FIG. 13—35,000 VOLT LINE NEAR CAPEL CURIG

Copper conductors, principally of 0·1 square inch section, composed of nineteen 0·083in. wires stranded, carried on "A" poles with a normal span of from 300ft. to 350ft., are used for the other lines. In many cases the lines have had to be taken up to elevations approaching 2000ft. above sea level, and in view of the exceptionally severe weather conditions which are sometimes experienced in those districts, higher factors of safety than are specified in the regulations for high-tension overhead transmission lines have been employed. Two typical examples of 35,000-volt lines are shown in Figs. 12 and 13. The first view represents the line between Cwm Dyli and Dolgarrog, running beside Lake Cowlyd at an elevation of 1170ft. above the sea. The smaller line of poles seen to the left-hand side in the illustration carries the original transmission line between the two generating stations, which has, we gather, now been practically superseded by the newer line. Fig. 13 shows a portion of the new line in the neighbourhood of Capel Curig. The pole in the foreground is a transposition pole. Both these views give a good idea of the wild nature of the country traversed.

The switchgear in the sub-stations is of various types. In the earlier sub-stations which supply the North Wales coast towns, the 33,000-volt switchgear is of the cubicle type, and the 11,000-volt gear of the truck type. Recently, however, metal-clad gear has been extensively used. A considerable number of out-door sub-stations, in which the loads are small and only simple switching facilities are required, have been erected. Practically all the transformers are of the outdoor type. Typical examples of two of the out-door sub-stations are given in Figs. 10 and 11, which show the arrangements at Llanfrothen and Rivals respectively, constructed and equipped by Ferguson Pailin, Ltd. At Llanfrothen the sub-station gives a supply from a ring main to a branch feeder, and through a transformer to the district surrounding the sub-station. The ring main connections are controlled by air break switches only. The transformer is protected by tetrachloride fuses, and the branch feeder by an outdoor oil switch which is manually operated. The simplicity and inexpensive nature of the construction employed will be noted.

The principal and most important sub-station is that at Legacy, which serves as a switching centre for the eastern area. A description of it will, therefore, be of interest. Six main lines converge at this station —two from Maentwrog at 66,000 volts, two from Crewe at 33,000 volts, and two from Dolgarrog, *viâ* the coast, at the same pressure. In addition, there is a distribution system at 11,000 volts serving Wrexham, Oswestry, Mold and other towns in the surrounding area. The lines from Maentwrog are connected direct to the higher tension side of two 7500-kVA Ferranti transformers, which are fitted with on-load tap-changing gear. This gear has already been described in our columns, and need not again be dealt with here, but there is one adjunct to the transformers that calls for special mention. A side view of one of them, in position at Legacy, is given in Fig. 9. The apparatus is of such size that only by removing the insulators and other accessories at the top was it possible to transport it by rail, and it was quite out of the question to furnish it with integral cooling arrangements. A special design was therefore prepared with an entirely separate cooler, which is seen in the engraving. The two portions of the apparatus are connected at the top and bottom with light oil-circulating pipes, each pipe being furnished with expansion joints and having a valve at each end. When these valves are closed and the pipe joints are broken, it is quite an easy matter to withdraw the transformer, which is carried on four wheels, along the rails on which it stands, the cooler remaining undisturbed. The circulation of the oil is effected naturally, the heated oil passing from the transformer to the top of the cooler, its place being taken by cooled oil from the bottom of the cooler. The cooler comprises fourteen separate radiator units, each connected to a header at top and bottom, and so arranged that any one is capable of being removed without interruption of the supply. An oil conservator vessel is mounted above the top header. We understand that the whole arrangement, which is the first of its kind, has been most successful.

In addition to these transformers, there are two 2500-kVA units with a ratio of 33,000/11,000 volts for supplying the 11-kV network. These transformers were also made by Messrs. Ferranti, and, like the larger ones, they are of the out-door type. The switchgear for both the 11,000 and the 33,000-volt circuits is of the metal-clad type, and was made by Ferguson Pailin, Ltd. A booster transformer of the English Electric Company's manufacture is connected to one of the Crewe feeders to enable a constant voltage to be maintained at Legacy when power is being delivered from Runcorn to Crewe. Offices, stores, a garage and houses for the employees are provided at the sub-station, the site of which occupies several acres. A siding from the Great Western Railway runs alongside the transformer foundations.

At the principal sub-stations the 33,000 and 11,000-volt lines are generally connected to the switchgear by short lengths of cable. At out-door sub-stations the overhead lines are connected direct to transformers and switchgear without any lightning protection being fitted. As the network consists principally of overhead lines covering long distances, protective systems involving pilot wires are not used, and reliance is placed on overload and leakage relays with discriminating time lags for the main feeders.

In conclusion, we desire to tender our thanks to the consulting engineers, Messrs. Sir Douglas Fox and Partners, for their courtesy in furnishing us with the particulars and illustrations necessary for the preparation of these articles, and also for the trouble they have taken in correcting the proofs before publication. Both they and the various contractors are to be congratulated on the success which has attended the whole scheme, which in several respects has no precedent in this country. To mention only one item, the generating units at Maentwrog are the largest of their type which have hitherto been employed in Great Britain, and their operation has, we gather, been most satisfactory.

South African Engineering Notes.

Copper Developments in Northern Rhodesia.

In all probability a few years hence will see the Union Minière du Haut Katanga, Belgian Congo, the world's largest individual producer of copper. Copper production during 1927 amounted to 89,156 tons, as against 80,639 in 1926. The new reverberatory plant at Pauda has been started, and is giving satisfaction. Erection of the leaching plant is being pushed on actively, and it is expected to be ready for work by the end of 1929. The electrolytic refinery at Oolen, Belgium, has been completed, and is producing electrolytic copper from Katanga bar copper. During the first half of this year production was at the rate of 113,000 tons per annum, a rate which if maintained for the rest of the year will set a new record level. When the Pauda plant is commissioned late next year the output is expected to be at the rate of 140,000 tons per annum, with further increases to follow as additional units of plant are completed.

It is, however, by no means certain that in about a decade Northern Rhodesia will not surpass the Union Miniere in regard to total production, though it is doubtful if there are any copper deposits in Northern Rhodesia of such richness as those of the Union Minière. When it comes to ores carrying a percentage of from 3 to 5 per cent. copper, then the quantity which Northern Rhodesia possesses is incalculable. All facts go to strengthen the belief that before long Northern Rhodesia will be producing copper on a scale that will rival the Belgian Congo, and, if so, then undoubtedly this part of Africa, embracing Northern Rhodesia and the Belgian Congo, will be the outstanding factor in world copper in the future. The rapidity with which the development of mines is being pressed on is evident from the fact that an order has just been booked for two Crossley Premier suction gas engines with five producers for bituminous coal for the N'Kana mine. These engines will be coupled to British Thomson-Houston alternators. A Bellis Morcom motor-driven air compressor of 2000 cubic feet per minute is also being supplied. This plant will be installed at N'Kana as quickly as possible for the purpose of pushing on development and pumping by compressed air underground.

New Railway to the North.

A movement for a second main line, through the north-west districts of the Cape Province to Johannesburg, has become so strong that the matter has been seriously gone into by the Railway Board, and it seems likely that one of three alternative routes will be accepted and powers sought at the next session of Parliament to proceed with the work. One proposal which has much support is that a line should be constructed from Grigua Town to Fourteen Streams, which would make the new line 200 miles shorter than the existing line, and would serve large areas which are just coming under irrigation schemes. The route most favoured, however, is to continue the existing line from Cape Town to Ceres, a distance of 100 miles, on to the north. This would pass through Carnarvon and Prieska, and on to Postmasburg, where the recently discovered manganese deposits are situated, and then through Kumuman, joining the present line again at Vryburg. The Railway Board estimates that the cost would be about £7,000,000, but the benefits would make that sum appear a negligible consideration. During the year 1927 the losses of live stock owing to the drought in these districts was computed at £10,000,000, much of which would have been saved had this proposed railway been in existence, so that the stock could have been removed to pasturage in the north.

Benguella Railway.

Within a few weeks the Benguella Railway, which has its ocean terminus at Lobito Bay, and will link up with the C. F. K.—B. C. G. systems of the Congo at or near Tshilongo in the Katanga, will have reached the newly created frontier of the Congo and Angola (which has resulted from exchanges of territory) in the Diolo area. For access to the sea the Katanga has since its beginning been dependent on the Rhodesian railways and southern ports, but the two new railways now under construction, the one from Bukama to the Kasai River entirely in Congo territory, and the other the Benguella Railway from Lobito Bay across Angola, will soon provide two new main arteries for transportation. The new line will be through to Tshilongo in 1930, and already Lobito Bay is being marked out as one of the coming great ports of the African Continent.

A sandspit running parallel at the steep coast of the mainland forms the fine natural harbour of Lobito Bay, which lies about 20 miles north of the old town of Benguella, in Angola, on the West Coast of Africa. The harbour has an area of 4½ miles of deep water completely protected against storms. The largest liners can enter under any weather conditions at any time of the day, and be moored alongside the railway company's jetty.

Owing to its geographical position this port is destined to play a vital part in the development of Angola and Central Africa. It is not only the nearest outlet to the sea for these territories, but it also provides them the shortest sea voyage for their produce to the world's markets. The following table compares the distances between Southampton and South African ports. Beira to Southampton, 7855 miles; Cape Town to Southampton, 6350 miles; Lobito Bay to Southampton, 4900 miles. Whereas Elizabethville in the Belgian Congo, *viâ* Cape Town, is now a journey of some twenty-five days from London that town will be reached in eighteen days as soon as through communication *viâ* Lobito Bay has been established.

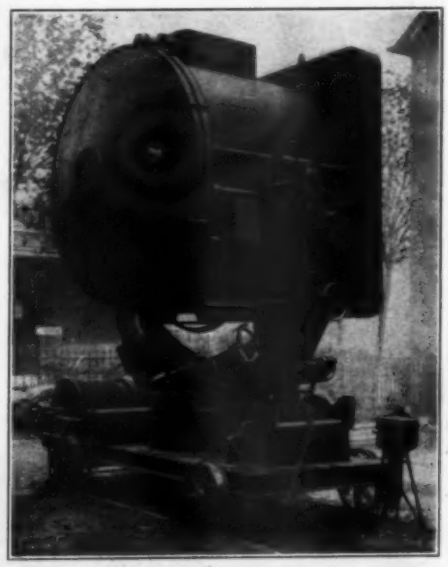
There is every possibility that in the near future the distance between London and Northern Rhodesia will be even further curtailed, since an air survey is now being undertaken to investigate the navigability of the Zambesi and Lungwe Bungu Rivers with a view to utilising these waterways as a means of communication between Livingstone and Lobito Bay. This would mean that the Victoria Falls would be brought within eighteen days of Charing Cross by a combined sea, rail and river route. Angola will be the first to benefit by the completion of the Benguella Railway and other engineering enterprises connected with it. The farming possibilities there are most promising. Experience has proved that coffee, sugar, oil seeds, maize, cotton, tobacco and sisal can be cultivated. The maize crop for 1927 exceeded 70,000 tons. There is a plentiful supply of water and cheap transport is available. There are already more than 20,000 miles of good motor roads in Angola.

Newcastle Blast-furnaces.

The quantity of pig iron consumed in the Union of South Africa is so limited, outside that used by the Union Steel Corporation, that after running for about fifteen months, during which time 56,209 tons were produced, the accumulation was so great that the Newcastle blast-furnace had to be blown out. Stocks having now been reduced, after over six months' cessation of production, the furnace is shortly to be blown in again. Advantage has been taken of the stop to reline the furnace. One great reason why the consumption of pig iron in South Africa is so small is that there is an enormous quantity of scrap iron in the country. For very many years all machinery, plant and iron and steel material required was entirely imported, and the quantity ran into many thousands of tons yearly. The result is that there are accumulated throughout the country enormous quantities of scrap which are available for engineering shops and foundries and for steel furnaces, and will not be exhausted for another decade or so.

A LARGE SEARCHLIGHT.

We illustrate below what is claimed to be one of the largest searchlights ever produced. It has been made by the London Electric Firm, of Brighton-road, South Croydon, and has a mirror 200 cm. in diameter. It is, as will be seen from the engraving, mounted on a truck for running on rails and has a seat for the operator, within



whose reach there are all the necessary controls, such as those for elevating, training and working the flashing shutter, which is of the Venetian type. There are also three different systems of control, namely, local hand, pan handle, and distance electric, and in connection with the latter a portable controller has been furnished which is coupled up to the ten-core control cable. This controller enables the projector to be trained and elevated at any distance away up to the length of the cable, which, in this case, is 100 m., and the shutter is operable from the same controller.

The shutter is an interesting part of the apparatus, as it can be worked by hand locally or from the controller, while the latter control gives quicker operation than is possible by hand. The two controls cannot inadvertently be left engaged at the same time, as one must be definitely declutched before the other is useable. The same applies to the geared movements, which are fitted with clutches and interlocking devices to prevent the projector being rotated at a distance if, for instance, the pan handle happens to be left in position. The pan handle projects 3 m. to 4 m. and enables the projector to be quickly rotated and elevated. The hand wheel at the end of the pan handle gives the same angular movement to the beam as the local elevating hand wheel. The lamp operates with a current of 200 ampères and is of the high-intensity type, yielding a very small crater. The positive carbon is rotated by a small motor, which also feeds both carbons forward.

Railway Matters.

THE annual dinner of the Institution of Railway Signal Engineers was held, under the presidency of Mr. W. S. Every, on Friday, November 2nd. The guest of the evening was Lieut.-Colonel Mount, one of the inspecting officers of the Ministry of Transport.

ONE of the changes consequent on the death of Mr. George Davidson, the divisional general manager at York for the London and North-Eastern Railway, and the appointment of Mr. Thomas Hornsby as his successor, has been the promotion to the position of district superintendent, Middlesbrough, of Mr. T. Bernard Hare, whose excellent little book on "British Railway Operation" was reviewed in THE ENGINEER of October 14th, 1927.

THE Southern Punjab is one of the three large railway systems in India—the other two are the Bengal and North-Western and the Rohilkund and Kumaon—that are company-owned, but worked by the State. Under the contract with the Government of India, the railway may be acquired at any date between December 31st, 1929, and December 31st, 1934. Notice has now been given that it will be acquired on the former date—the earliest possible.

IT was recorded in this column on January 20th last that the Ministry of Transport had appointed a departmental committee to review the recommendations made by the Electrification of Railways Advisory Committee, 1921, and to report what modifications, if any, should be made in those recommendations, having regard to the developments which have taken place since that date. The report of this further committee has now been issued as a Stationary Office publication, price 6s. 6d.

TRAVELLERS by the Great Western line between Exeter and Teignmouth will remember how the line at Dawlish passes between the town and the sea. Access to the shore has to be obtained by an opening under the railway near the station, which had nine spans, from 11ft. to 13ft. in length. The structure was built in 1846, and when the local authorities heard that it was to be renewed they asked that the viaduct might be improved from the town's point of view. As a consequence, it has been rebuilt in three spans, and the whole structure is now spoken of as being of very pleasant design.

THE coroner's jury which has been inquiring into the deaths arising out of the Charfield railway disaster of October 13th, returned a verdict to the effect that the signalman committed no irregularity; that the signalling was in good order; that there was no necessity for fog signalmen to be out, and that they were unanimously of the opinion that the collision was caused by the negligence of the driver of the mail passing his signals when at "danger." The coroner, who had the assistance of Colonel Sir John Pringle, said that he must interpret that as a verdict of manslaughter, and the driver was committed for trial accordingly.

IN an interview an officer of the London Underground Railways has given to a Press representative, it was stated that in addition to the forthcoming Bill to sanction co-operation with the London County Council's tramways and the establishment of a common pool, powers are to be sought to extend the Piccadilly Railway to Southgate and from Hammersmith to Southfields. The former is to meet the need for additional transit facilities in North-East London, whilst the latter will save the change to or from the District Railway at Hammersmith, and will duplicate that company's facilities in the greater part of the distance to Richmond, Hounslow and Ealing.

IT is officially announced that the automatic train control system used on the Great Western Railway is to be further extended, as its use in advising drivers as to the condition of the signals in fog has been found very valuable. We would add that, as related in this column of our issue of September 9th, 1927, all new engines and those rebuilt are being equipped with the apparatus. It should, on the other hand, be remembered that this question is now under consideration by a Departmental Committee of the Ministry of Transport, and that, because of the conductor rails, where lines are electrically operated, and because of the intersection rails at junctions, sidings and cross-overs, the ramp system—the method employed on the Great Western—is considered to have serious objections.

THE lines of the Pennsylvania Company that are operated by electric traction are those in the New York Terminus as far south as Manhattan Transfer, parts of the Long Island Railroad, and between Philadelphia and Paoli, a distance of 20 miles. The New York correspondent of *The Times*, under date November 1st, now cables that the whole of the line between New York, *i.e.*, Manhattan Transfer, and Wilmington is to be converted at a cost of 100,000,000 dollars (say, £20,000,000). The cable says that the work covers 325 miles of line and 13,000 miles of track, and that "the electrification would far exceed in magnitude and importance that of any other railway in the world." As the route mileage between New York and Wilmington is only 115 miles, the size of the new undertaking will be much less than that on our own Southern Railway, where the route mileage is 355¾ and the track mileage 875. The 13,000 miles of track includes, no doubt, sidings, but, there again, it is hard to credit that there are 100 miles of sidings to each route mile of railway.

IN reporting the buffer stop collision of August 27th at Euston in our issue of the 31st *idem*, we observed that "It is always a ticklish job to take a heavy train into a terminal station, especially when, owing to the length of the train, it is necessary to run up to the buffer stops. Particularly is that the case with Euston, as it is approached by a long length of falling gradient of from 1 in 70 to 1 in 112. The entrance into Nos. 1 and 2 platform roads is made yet more difficult by the curvature of the line, which gives a driver a rather short view of the buffer stops." The report by Lieut.-Colonel Mount on that collision has just been issued, and it appears that the driver admitted that the accident was the direct outcome of his misjudgment. The inspecting officer, however, adds:—"The accurate manipulation of a train into any terminal is an operation requiring judgment, skill, and confidence. It depends upon a proper estimation of speed and distance and a nicety of touch in the operation of the power brake, only acquired by considerable experience."

Notes and Memoranda.

THE annual world production of tartaric acid is estimated at about 20,000 tons. Of this quantity, 9500 tons is contributed by the German-Italian Syndicate, 5000 tons of this being made in Italy. France produces 2000 tons, England 2500 tons, America 3500 tons, Austria 500 tons, Spain 500 tons, Australia 500 tons, and Poland, the Balkan Countries and Russia, together 1000 tons. It is stated that the production capacity of the German-Italian Syndicate is 12,000 tons a year.

A LIST of life-saving stations of the world, now in its second and much revised edition, is published by the International Hydrographic Bureau as *Publication* 18, price 30 cents. It gives the name, latitude, and longitude and kind of apparatus kept at every station in the world. The text is in both English and French, and the Bureau gives full permission to anyone to reproduce the work in any other language. The most noticeable feature is the long list of countries on the coasts of which there are no life-saving stations.

A RIVAL to the Transatlantic wireless telephone service is foreshadowed by the announcement of the Bell Telephone Company of New York, that its engineers have perfected a cable which can be used for submarine telephony over long distances. The construction of a Transatlantic telephone cable is now under consideration. Meanwhile it is interesting to note that the British Post Office and the American Telegraph Company have decided to build additional wireless transmitters for the Atlantic telephone service. There are at present two channels available, and it is hoped that a further transmitter may be available by July next. The construction of yet another is being considered.

THE United States Department of Agriculture has pressed the aeroplane into service in the exploration it continually carries on for new varieties of plants that may be of value if brought under cultivation. Dr. D. W. Brandes has recently returned from the interior of New Guinea, where he has been using this method to hunt for new varieties of sugar cane; 171 distinct varieties of cane were secured, one of them a species described as new to science. Collected by this rapid method of transport, the canes are being brought back alive, and will be put under cultivation in suitable regions in the United States. They can then be used for purposes of hybridisation and examined as to their possibilities of disease resistance.

THE new mercury boiler and turbine installation at the South Meadow station of the Hartford Electric Light Company, United States of America, was brought up to speed on October 4th, and carried about 1200 kW for a short time. Heat was first put on the boiler on September 25th, and some slight modifications were made prior to resuming operations. According to vice-president T. H. Soren, the initial operation proved entirely satisfactory, and it was decided to continue putting the unit on the line for increasing periods and loads. The unit has a total output of about 20,000 kW, of which half is in the form of steam for ordinary turbine service and the remainder is energy delivered by the mercury-driven generator.

THE question of extracting oil from coal by a low-temperature process, states the *Chemical Trade Journal and Chemical Engineer*, is followed with great interest in Norway, where it is of great importance, particularly as it has been established that Svalbard coals contain a large percentage of oil and are well suited for the process mentioned. A commission was appointed to investigate the matter, but so far has not reported. Meanwhile, it has been stated that a British company, the Maissel Corporation, with offices in London and Reval, is carrying out experiments at a plant in Scotland, and has planned the erection of a plant at Bergen for the purpose of utilising Svalbard coal. Apparently, however, these plans are still in a preliminary stage.

CLAIMS are frequently made that excellence of copper bar material and first-class brushes are the main factors which determine perfect performance and long life of commutators. While these two are undoubtedly important contributing factors, mechanical precision is claimed by the author of an article in the *Oerlikon Bulletin* to be of paramount importance. Great progress has been made in this respect during the last few years, particularly in connection with commutators for single-phase locomotive motors. It is shown that minute deviations from the perfect circular periphery may cause a rapid deterioration of the commutator. A formula is offered which gives the maximum permissible variation from true round shape without lifting the brushes off and causing arcing. Some of the steps are described, in the manufacture of commutators, such as bar assembly, cone design, diamond grinding and balancing. Statistical data, compiled by the Swiss Federal Railways, covering the performance of commutators on 103 locomotives, indicate that a life of as high as 300,000 locomotive miles has been given by some commutators before redressing was found necessary.

BEFORE a meeting of the American Society for Steel Treating a paper was read by Mr. Frank R. Palmer, according to which a novel application of zirconium sulphide has solved a difficult problem. In the machining and grinding of some of the high-chromium steels, trouble has been experienced. The chips often adhered to the cutting tool, with similar difficulties in grinding. Taking as a basis the known effect of fairly high percentages of sulphur and phosphorus on the machinability of certain steels, it was ascertained that the presence of 0·40 per cent. of zirconium sulphide in the chromium alloys had the same effect on the machinability and grinding properties as 0·30 per cent. sulphur. The alloy steels, however, were easily worked with the presence of the zirconium sulphide, whereas they could not be with a high-sulphur content. Thus, by introducing the sulphide of zirconium, the machining and grinding properties of rustless iron were greatly improved. The author also announced that the presence of this sulphide did not impair the resistance to corrosion nor to scaling at high temperatures, and that the alloys could be forged or rolled under 2100 deg. Fah. The sulphide did, however, decrease ductility and lower the Izod value. Microscopically, it did not dissolve in the ferrite, but was distributed as nuclei.

Miscellanea.

IN the presence of a large gathering of officials and workmen of the Staveley Coal and Iron Company, a memorial tablet to the late Mr. Charles Markham was recently unveiled at the company's Devonshire Works offices.

THE British Broadcasting Corporation announces that a series of six talks, entitled "Tendencies in Industry To-day," will be given on Friday evenings at 7.25 p.m., starting to-day, November 9th. In this series, which will be broadcast from 2LO, 5XX, and other stations, several of the most urgent and controversial subjects of the day will be discussed frankly and with conviction by speakers of every shade of political opinion.

PLANS for standardisation of Diesel engine fittings are described in a bulletin of the American Society of Mechanical Engineers. The bulletin points out that certain small parts, such as piston rings and spray valves, are manufactured by speciality concerns, and that standardisation would enable these manufacturers to contribute largely to the reduction of engine-making costs. A committee of the oil and gas power division is at work on the subject.

THE General Post Office is in communication with the Governments of the Australian Commonwealth, South Africa, and India, with a view to bringing the whole of the Empire into wireless telephonic communication with Great Britain. A telephone service between London and Canada was opened in October, 1927, by a conversation between Mr. Baldwin and Mr. Mackenzie King, as part of the Transatlantic Telephone Service, and it has since been extended to include all parts of the provinces of Ontario and Quebec. The success of the Transatlantic Service has given rise to the hope of bringing all parts of the Empire within reach of the human voice.

PROBABLY within a year a wireless telephone system, costing £45,000, will be in operation between London and Melbourne. The Postmaster-General, Mr. Gibson, who made this announcement in the House of Representatives, also stated that at an early date it was hoped to establish a wireless telephone service between Tasmania and the mainland, and to provide a metallic telephone circuit between Adelaide and Perth. Inquiries were proceeding, he said, to determine the possibility of introducing wireless telephony services to replace trunk line services over long distances in Australia, so that the heavy cost of erecting thousands of miles of wire might be avoided.

CONSIDERABLE interest has been taken in the suggestions put forward by the Association of Supervising Electrical Engineers for an apprenticeship scheme for the electrical industry. The bodies interested in the scheme are giving the matter serious consideration, and letters of inquiry are being received from all parts of the country. It is said to be the intention to call a meeting of all organisations concerned with a view to the formation of a committee representative of all bodies affected, whose terms of reference will be to work on agreed principles. The final details of the meeting have not yet been settled, but it is hoped an agreeable date and time will be decided shortly, in conjunction with the various organisations.

CONSIDERABLE attention, states *Electro-Farming*, has been drawn to the farm of the Prince of Wales at Lenton (Notts.), as electricity is used upon it to a certain extent—though not as much as modern experience would dictate. His latest electrical venture is upon his Canadian ranch. This ranch is situated about sixty-five miles south of Calgary and is composed of some 6000 acres of well watered arable, pasture and woodlands. The installation by the Prince of two private electric generating plants to serve the needs of this estate will bring electricity on the farm into further prominence, and the success of his enterprise will act as a valuable stimulus to others. Already two electric pumping systems have been installed, and other equipment will follow in due course.

THE British Government is sending delegates to an International Conference which opens in Paris on November 12th for the purpose of discussing the question of the limitation and regulation of the number of international exhibitions and for concluding an International Convention on the matter. A Convention on this subject was signed at Berlin in 1912, but owing to the outbreak of war before ratifications had been exchanged, the Convention never came into force. The main object of the forthcoming Conference will be to seek to limit strictly the long-period general exhibition, which is organised in many cases primarily for sentimental reasons, and from which the commercial results likely to accrue to participants do not repay the cost of sending a creditable exhibit. It is understood that the British Government takes the view, after consultation with trade interests, that the short-period trade exhibition or fair stands in a different category and in the main is a valuable aid to business.

THE Government of the Saskatchewan Province has taken initial steps in the direction of the inauguration of a provincial electricity supply following the recommendation of the Saskatchewan Power Commission favouring central control and operation of generation and distribution. A Committee of the Cabinet has been appointed to visit Saskatoon in order to inquire into the immediate power requirements of that city, and to consider the possibility of developing a plan for the distribution of power outside the municipal area. If an agreement is reached, Saskatoon will be the nucleus of the northern power system. The Saskatchewan Power Commission appointed by the Provincial Government on July 21st, reported unequivocally in favour of Government ownership and operation of the generation and distribution of electrical energy in Saskatchewan, and recommended the immediate purchase of the municipal plants at Regina, Moose Jaw, and Saskatoon, as the initial step in the development of a provincial scheme. The plans called for immediate rebuilding of the Saskatoon plant at a cost of 1,500,000 dollars and envisaged a capital investment, covering purchases and extension of plants, of 6,700,000 dollars. The Commission strongly favoured placing control under one central authority with a northern and southern system of main transmission lines and secondary systems ultimately to be linked into a vast network over the entire Province.

NORTH WALES ELECTRICITY SUPPLY—66,000-VOLT TRANSMISSION LINES

(*For description see page 514*)

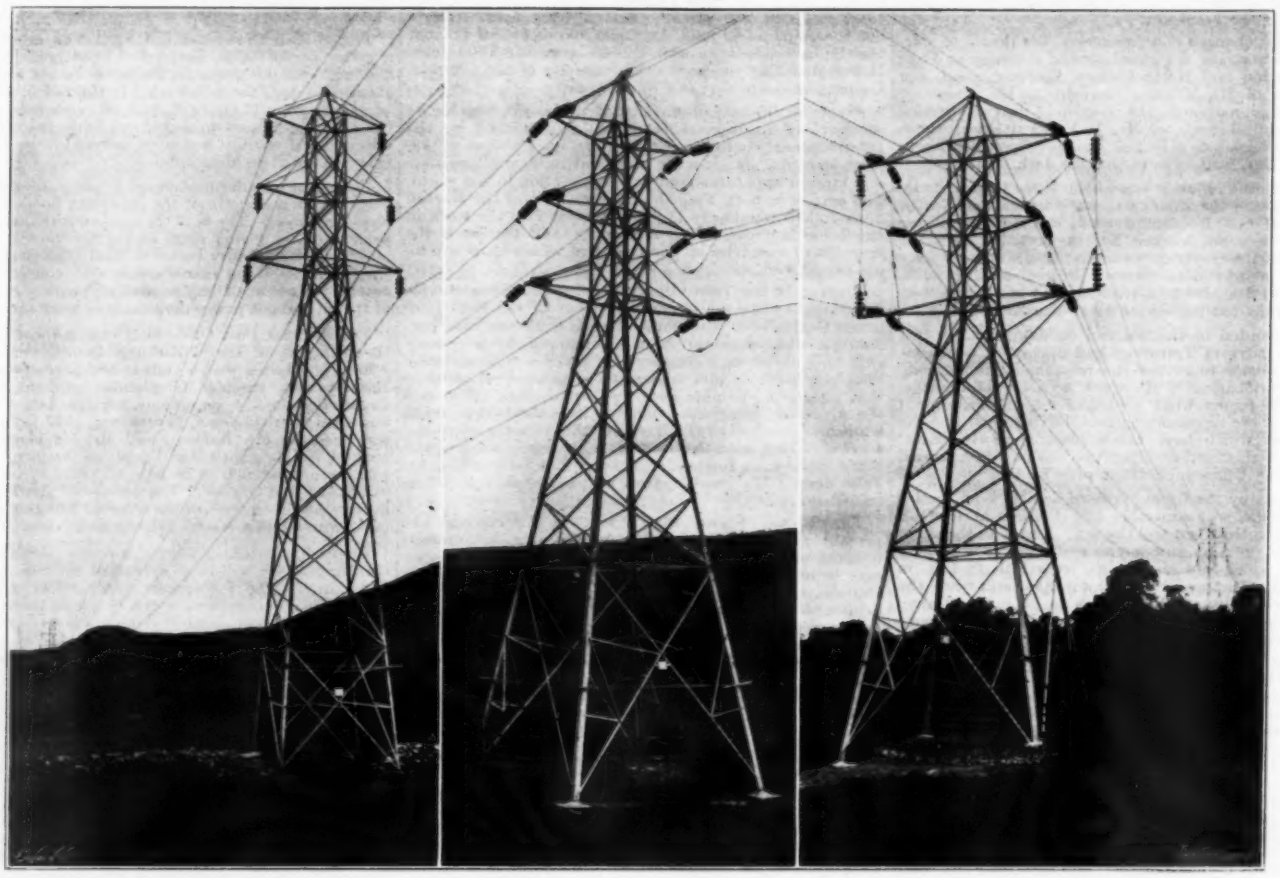


FIG. 14—NORMAL INTERMEDIATE TOWER

FIG. 15—ANCHOR TOWER

FIG. 16—TRANSPOSITION TOWER

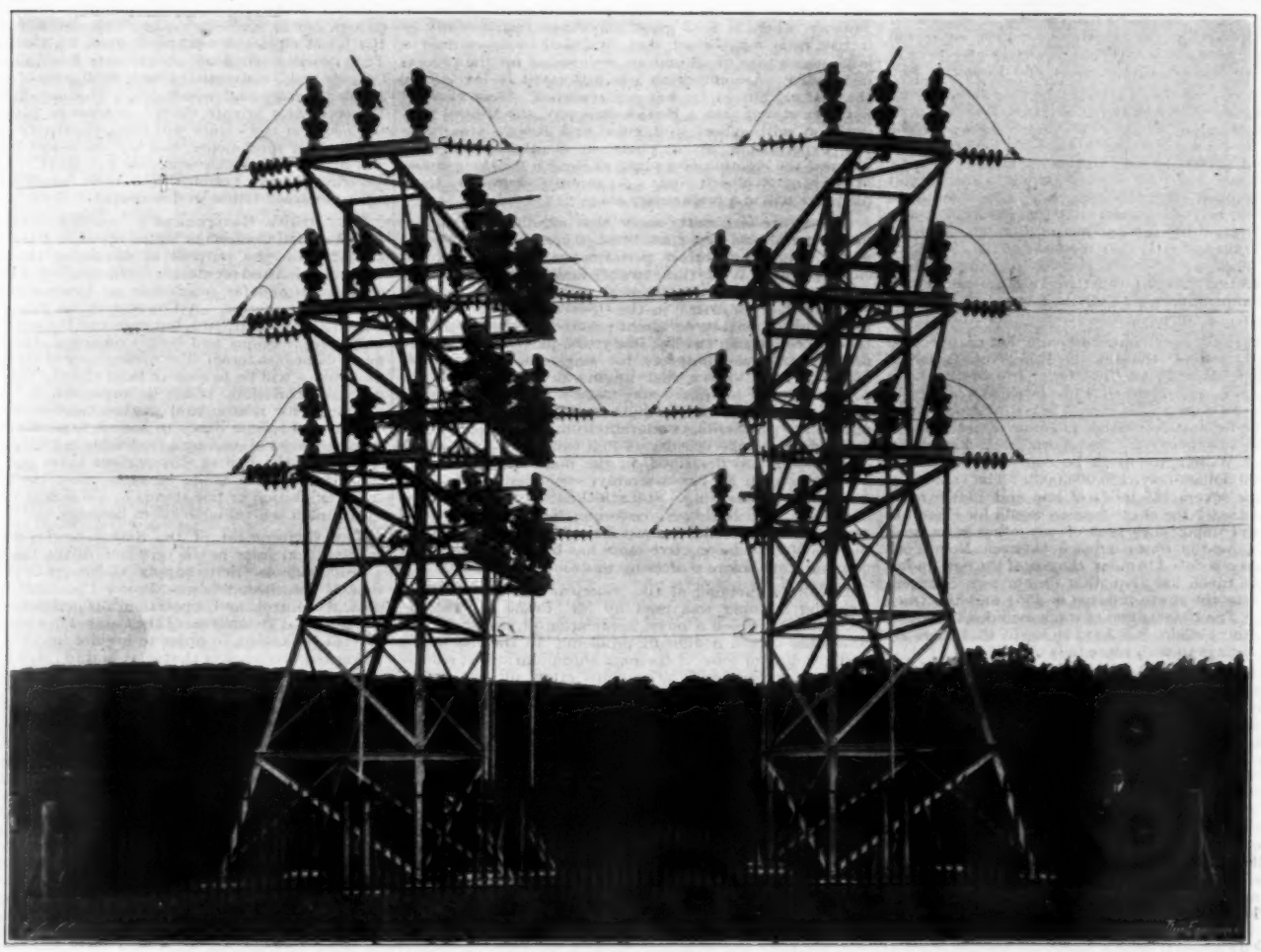


FIG. 17—SWITCHING STATION AT CORWEN

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THE ENGINEER.

NOVEMBER 9, 1928.

British Patents.

IN April, 1927, the British Science Guild appointed a committee "to consider what changes could advantageously be made in the British patent law." The committee consisted of seventeen members, with Dr. W. H. Eccles as chairman. Captain C. W. Hume acted as secretary. The weakness of the committee was the over-representation of the law and the patent agencies upon it; the absence, with the notable exception of Dr. Eccles and Lieut.-Colonel O'Meara, formerly Engineer-in-Chief of the Post Office, of any engineers and the total absence of any manufacturing engineers. Indeed, the representation of industry was very poor indeed, and the lawyers, with whom we include the patent agents, must have dominated the work of the committee. Whilst we admit that manufacturers are not generally acquainted with the legal intricacies of patent law, we submit that, since they are deeply interested in the application of those laws, their opinions would have been valuable. The result of the preponderance of the legal profession is that the recommendations made by the committee neglect certain aspects of the use of patents which demand consideration, and are almost solely concerned with those, less industrially important aspects, which are associated with litigation. The only recommendations which can be deemed of direct value to industry are that Empire patents and "short-term patents," somewhat similar to the German "Gebrauchsmüster," should be instituted.

There is a common belief that an industrial country cannot flourish unless it makes the grant of monopolies to inventors easy and cheap. The objection to monopolies which is stoutly upheld in all other directions is not only withdrawn in the case of inventions, but is replaced by a direct incitement to secure them. It is said that without the encouragement to invent which the glamour of a patent holds out, the native ingenuity of our people would lie dormant, and we should cease to progress. It may be so; we cannot say. The evidence of Holland may really point in that direction. The Dutch abolished patents for inventions in 1869 and re-established them again in 1912. It would be interesting to know if they have, indeed, become more inventive in the last sixteen years than they were in the preceding forty-three. The committee does not tell us. It is more probable that since 1912 Holland has become the ground for the exploitation of foreign inventions. If even a moderate proportion of the inventions which by the ingenuity of patent agents and the complacency of the Patent Office manage to secure protection was really worth while, if it really showed a fairly high standard of inventiveness, there would be something to be said for that contention. As a matter of fact, the number of really useful inventions which merit the protection they obtain is very small, and the number of "outside" inventors who benefit industry is smaller still. The great bulk of useful inventions are made by people in the industry, who would make them in any case in order to keep ahead of their competitors. Indeed, some manufacturers go too far, for they patent everything that is likely in the remotest degree to be useful to them or to others, and year after year there are added to the Patent Office files hundreds—possibly thousands—of patents which are virtually no more than notices that "Trespassers will be prosecuted." Our readers will find the study of our weekly selected patents interesting in this and other respects. They will notice how frequently the same names of firms occur. It may be said with certainty that only a small proportion of these inventions ever find their way into industry; they have been patented to prevent other people making use of them. That is a defect of the patent system which has never been adequately attacked. The useless patents are, no doubt, allowed to lapse after a few years, but in the meantime they have destroyed, by publication, the chance of anyone else to secure protection. Readers will observe, too, if they study even the very small selection of patents that we are able to make week by week, that some of them have to the eye of common sense no novelty whatever. Technically, the Patent Office manages to persuade itself that they come within the rules. Why refuse good guineas? It may be that the extension of "search" which the present committee advocates would reduce that defect, but we are inclined to doubt it; particularly as the committee recommends that the present fifty-year limit should not be extended. It refers to the alleged superiority of German and American patents because a search of unrestricted scope is undertaken. Perhaps it may be true "that financiers sometimes withhold their support from inventions which have been subjected only to the restricted examination which is practised in Great Britain." But Mr. Bolderos are, we fancy, not unknown in the real financial world as well as in the lurid world of Mr. Aldous Huxley. "If it weren't for the friendship and respect which I feel for your father, Mr. Gumbril," he said, twinkling genially over the brandy, "I'd just annex your Small-Clothes, bag and baggage. Just annex them." "Ah, but they're my patent," said Gumbril. Mr. Boldero laughed. "Do you suppose that would trouble me if I wanted to be unscrupulous? I'd just take the idea and manufacture the article. You'd bring an action. I'd have it defended with all the professional erudition that could be brought. You'd find yourself in for a case that might cost thousands. And how would you pay for it? You'd be forced to come to an agreement out of court, Mr. Gumbril. That's what you'd have to do. And a damned bad agreement it would be for you, I can tell you." Mr. Boldero laughed very cheerfully at the thought of the badness of this agreement. "But don't be alarmed," he said. "I shan't do it, you know." It is a pity, perhaps, that the Boldero method is not employed more often. It would put an end to the existence of many patents which have no right to exist. As a rule, it is exercised only, as in the case of Gumbril's Pneumatic Small-Clothes—certainly an invention that could claim novelty!—when the inventor is not in a financial position to defend his patent. Where the inventors are strong, even when novelty is doubtful, it is deemed wiser to pay the royalties than to risk an action. There are not a few important inventions, some of them foreign, in use under licence in this country at the present time which might have been safely infringed by a Mr. Boldero. The costliness of litigation deters justice; sometimes on one side and sometimes on the other. Proposals made by the committee for

the simplification of legal procedure will therefore receive sympathetic attention. It considers it desirable that the Comptroller should be empowered to act as a Court, subject to a definite limit of damages and to the consent of both parties, and it is strongly of opinion that the legal remedy for unwarranted threats in connection with patents should be considerably strengthened. On both of these matters we shall hope to hear more.

We find ourselves wondering sometimes who it is that at not infrequent intervals drags the patent law from its quiet bed for castigation. Take it for all in all, the complaints about it in industry are neither frequent nor severe. Even this committee of reform has to admit that it is working fairly successfully. There were amending Acts in 1914, 1919, and this year. Can it really be that the conditions have so changed that further modification is already necessary? There is, we believe, no aspect of the British patent system which has not been discussed a hundred times, no aspect that was not presented when the last revision of the law was made. The committee refers to new conditions, but is there anything worthy of that name since 1919? One upon which stress is laid is the growth in scientific knowledge arising from research. It is feared "by some research workers that the validity of patents for research inventions may be imperilled by the circumstances of their origin." That is to say, that if the term "skilled workman" be applicable to scientists employed by industrial concerns, then "nothing that results from the work that such scientists are paid to perform can contain legal subject-matter or constitute a patentable invention." There are scores and scores of patents based upon research work done by scientists, and we have never heard it seriously suggested that such work should be unpatentable. Yet the committee seems to have discovered a few cases in which the law throws a doubt upon it, and as long as "the law is an ass," it may be necessary to make provisions which common sense proclaims unnecessary. On that, as upon other points, the report itself should be studied. We may add that it is tempered throughout by a fine moderation, and though we may still have a doubt that the work of the committee was seriously called for, we must admit that it makes its proposals and recommendations with restraint and dignity, and even if nothing comes of it, the ventilation of certain matters connected with patents can scarcely fail to clear the air.

The Outlook for Shipping and Shipbuilding.

SOME uncertainty appears to exist in the public mind as to the present position and prospects of the shipping and shipbuilding industries, owing to contradictory reports which have received publicity during the current year. Up to the end of March, at any rate, the considerable volume of work in hand at the shipyards created an impression of prosperity, which was made the most of by the popular Press. Even before then, however, shipbuilding authorities had been warning the country not to be misled by appearances. The exceptional number of ships building in 1927 and the early months of 1928 were accounted for in great measure by the labour troubles, and especially the coal stoppage, of 1926, which had the effect both of delaying work already in progress and checking the normal flow of new orders. Consequently, the settlement of these labour disputes was followed by a period of marked activity, for the shipyards had to make up their heavy arrears of work and shipowners began to place contracts for the new vessels which they had naturally refrained from ordering while the industrial outlook remained so obscure. As a result, the shipbuilding statistics for 1927 made an impressive display, but the "boom" was at once artificial and transient, and is now definitely at an end. The amount of tonnage under construction at the end of September —1,089,760 tons—was nearly 450,000 tons less than the total in hand twelve months ago. Within the same period the returns for the Clyde district declined by 27·7 per cent., while on the North-East Coast there was a reduction of no less than 47 per cent. At the present time British yards in general are suffering from a serious dearth of work. It is important that this fact should be widely recognised, for the welfare of a large proportion of our population is bound up with the state of the shipbuilding and kindred trades. The position is unsatisfactory, and we do not presume to say how it may be alleviated.

Great Britain is still, by a large margin, the premier shipping nation. Possessing as we do an enormous fleet of ocean carriers, there must always be a more or less steady demand for new bottoms, either to replace obsolete material or to meet the increasing requirements of seaborne trade. Nowadays, however, the heavy cost of new tonnage deters many shipowners from modernising their fleets as rapidly as they might have done had building costs been lower, and that is one reason why so many berths are lying vacant. Another and perhaps more cogent reason is the excess of world tonnage in relation to demand. Since the war there has been no such expansion of overseas trade as was anticipated. This is due to several causes, among which may be cited lofty tariff walls, financial exhaustion on the part of former belligerents—in Europe, if not elsewhere—and the development of domestic industries and resources by certain nations under the stress of war conditions, a process which has rendered them less dependent on external sources of supply. One result of the latter phenomenon is seen in the shrinkage of our coal exports. British shipping, moreover, has now to contend with competition on a scale undreamt of before the war. The magnitude of this competition is best revealed by a few figures. Between 1914 and 1928 the tonnage owned in the British Isles increased by 1¼ per cent. In the same period the tonnage owned abroad increased by 66¼ per cent. It is true that not all of this foreign shipping is actively employed. Of the American merchant fleet alone about 30 per cent. is laid up. But when every allowance has been made the fact remains that foreign competition in the shipping trade is much more keen and determined than ever before. By means of subsidies and other forms of encouragement, direct and indirect, the United States and various other Governments are doing their utmost to stimulate the growth of their respective merchant fleets. British shipping, on the other hand, has to fend for itself. In these circumstances it was inevitable that some ground should be lost, but on the whole the loss has been smaller than might reasonably have been expected. So far from taking a gloomy view of the situation, we are confident that our shipping industry will maintain its lead. Not the least encouraging portent is to be discerned in our undoubted supremacy as regards both the operation and construction of ships. It is safe to say that none but British shipowners could have weathered so well the economic tempests of the post-war period. Shipping management on purely commercial lines, as distinct from a State-aided basis, is not less a science than a trade. The history of the industry to date shows very clearly, we think, that in British owners as a class there is a natural aptitude for the business, and to this, probably as much as to their wide experience, they owe their pre-eminent position. In the design and construction of ships and their machinery this country still ranks first. Certainly the standard of workmanship has never been higher. For several years after the war our yards were severely handicapped, on the one hand, by the high cost of labour and materials, and on the other by the burden of exorbitant rates. They were therefore unable to compete on equal terms with continental rivals. Although these disabilities still persist in a marked degree, reorganisation, the adoption of new methods, and, above all, the cultivation of harmonious relations between employers and workpeople have so far diminished the former handicap that in the matter of home and foreign contracts British yards have lately been holding their own in the teeth of continental competition. At the end of September the total tonnage building throughout the world amounted to 2,521,342 tons. Of this sum, British yards were contributing 43·2 per cent. and foreign establishments 56·8. Comparing these percentages with the average for the last twelve months before the war—57·2 for the United Kingdom and 42·8 for other countries—it will be seen that we have fallen behind to some extent, but when all relevant circumstances are taken into consideration, the decline is less serious than it appears to be. Under the impetus of the war-time and post-war demand for tonnage, the shipbuilding industry abroad underwent abnormal development, and desperate efforts are still being made to keep as many berths occupied as possible. This is especially the case in Scandinavia, Italy, and France. The United States, which at one time showed signs of becoming our most formidable competitor, is now turning out very few ships, nor, in spite of the lavish financial assistance offered by the Jones-White Act, are American shipowners evincing any great haste in the ordering of new tonnage. German shipyards, irrespective of the strike now in progress, are far from prosperous. Many of them have been building for years either at a negligible margin of profit or at a dead loss. Two important yards have recently closed down—the Tecklenborg at Geestemünde and the Vulkan at Stettin—and others are expected to follow. So far, therefore, from the shipbuilding depression being confined to this country, it is universal, and there is no reason to suppose that the British industry is suffering more severely than its competitors abroad.

In the meantime, our leading shipping companies are displaying a spirit of enterprise which deserves full recognition. During the past few years they have ordered a series of splendid liners which will ensure the retention of British leadership in this class of tonnage. The German bid for the blue riband of the Atlantic has not gone unchallenged. In due course, the "Europa" and "Bremen" will be excelled in size, safety, and comfort, and possibly in speed, by the White Star "super-Olympic" now on the stocks at Belfast. The Cunard Company also is understood to have in view the building of a "super-Mauretania," which will worthily uphold the splendid traditions of her prototype. The Canadian Pacific Company has recently ordered on the Clyde a 40,000-ton liner, "Empress of Britain," which will be the second largest ship to be laid down in Great Britain since the war. Incidentally, the completion of this vessel may open a new era in Transatlantic travel, for, thanks to her speed of 24 knots and the shorter run to Canadian ports, it will be possible for her passengers to reach Chicago and the Pacific Coast as quickly as if they travelled by the fastest ships on the New York service, perhaps even more quickly. As regards services to the East, both the P. and O. and the Orient Line have ships built and building which entirely eclipse the finest craft under foreign flags, while our communications with South America and the West African Coast are being steadily improved as a result of the progressive building policies of the Royal Mail Steam Packet Company and the Elder Dempster firm. We could easily name a dozen other companies which are doing their best to maintain the supremacy of the Red Ensign, and at the same time to keep our shipyards busy with work of the highest quality. Facts such as these represent the silver lining to the cloud which continues to overshadow our maritime industries.

Railway Electrification.

ON November 11th, 1927, an Electric Railway Committee was appointed by the Minister of Transport to review the recommendations made by the Electrification of Railways Advisory Committee of 1921, and to report on what modifications, if any, should be made in these recommendations, having regard to the developments that have taken place since that date. Briefly, the conclusions of the Committee are that all railways in this country should be worked with direct current, and that the maximum voltages should be 750 and 1500 volts at the sub-station bus-bars, although a company may apply for approval to employ 3000 volts in special cases. All motors constructed in future for the higher or lower voltage systems are to be capable of operating satisfactorily on the higher or lower maximum standard voltages respectively; that is to say, a 600-volt motor must be capable of working at 750 volts. The primary supply is to be in the form of three-phase, 50-cycle current. For high-voltage working overhead collection is to be employed, whilst the current will return to the sub-stations by the uninsulated running rails. Third-rail collection may, however, be specially approved in cases where technical, structural or economic conditions justify its adoption, provided that due regard is paid to safety. For low voltage working, third-rail collection with an uninsulated return by rails is specified, and a fourth rail may be permitted for tube lines and for limite extensions of systems now employing an insulated return. All locomotives are to be constructed within one or other of two loading gauges, set out in drawings, which accompany the report. Electric locomotives intended for inter-running are to be equipped on first construction with lower voltage motors designed to work on the maximum higher voltage with series parallel switching and the necessary equipment for dual working. A standard type of bow collector for overhead collection and a suitable shoe collector gear for rail collection are to be employed. Details of the standardised third-rail and overhead equipment are given, and attention is paid to the questions of preventing electrolysis and inductive interference.

The Committee considers that the regulations limiting the drop of potential in uninsulated conductors on electrically operated lines are undesirable, and it suggests that certain regulations may be made with a view to preventing electrolysis and inductive interference. Briefly, it is proposed that the railway shall install proper bonds and take steps to keep them in good order, so as to maintain the conductivity of the running rails, and any supplementary conductors connected to them. The design of the bonds is to be such that the resistance of a joint, together with 3ft. of rail, shall not exceed that of 6ft. of unjointed rail, and the bonded joint shall be maintained so that its resistance, including 3ft. of rail, shall not exceed 10ft. of unjointed rail. This will, of course, entail carrying out tests at intervals in order to ensure that the standards set forth are being maintained. With the exception of such of the running rails and of any supplementary conductors laid on the sleepers as form part of the return circuit, together with the bonds of such rails and conductors, all parts of the return circuit extraneous to the rolling stock must be insulated. The sub-station negative bus-bar must not be permanently connected to an earth plate or to any special earthing system, whilst the earth return circuit, together with such of the permanent way, signalling and other railway appliances and structures as are in metallic connection therewith, must be electrically separated, so far as railway construction will reasonably permit, from the general body of the earth, extraneous to the railway and from any system of gas, water or other metallic pipes or lead-covered or armoured cables belonging to other parties. Precautions must be taken, according to the conditions of the site, to prevent any mast carrying contact feeder or transmission lines from acting as a path for earth currents from the railway system. Lastly, to avoid injurious inductive effects, the electrical machinery supplying direct current to a third rail or overhead line must be so designed as to reduce tooth ripples in the direct-current voltage to within the limits prescribed by the British Engineering standard specifications.

It is satisfactory to find that in submitting its report for the consideration of the Minister of Transport, the Committee recommends that in view of future improvements in electrical equipment and design, the conclusions and recommendations should be reviewed after a period of years, and an opportunity afforded of revising them if need be. Like other branches of electrical engineering, railway electrification has not reached the state of finality. Indeed, it appears to us that there is much room for improvement in the field of long-distance schemes. Up to the present, the railway companies of this country have shown little inclination to electrify their main lines, and there is no doubt that the high initial cost is the main obstacle. Possibly, it can be shown that all known systems are expensive, and that little is to be gained by substituting one system for another. That, at any rate, appears to be the opinion of British manufacturers and consulting engineers, but the fact remains that beyond endeavouring to raise the working pressure of direct-current railways, little attempt has been made in this country to break away from old ideas. In other countries, on the other hand, efforts have been made to employ something more simple. Since the introduction of automatic sub-stations, the possibility of working long-distance British lines with alternating current seems to have been ignored. The proposal to standardise direct current is still regarded as sound, notwithstanding that it will involve the erection of very many sub-stations. Whereas the alternating-current system of generation, transmission and distribution is being standardised for industrial and domestic purposes, the direct-current system is to remain standard for railways. In a few years' time, however, it may be found that long-distance trains can work satisfactorily with 50-cycle current collected from a single overhead wire, and that this system of operation offers distinct advantages. Standardisation is, no doubt, desirable, provided that it applies to something that is simple and cheap. But to saddle this country with something which in a few years' time may easily prove obsolete or at any rate undesirable, is not likely to advance the cause of main line electrification. One of the things that this country badly needs is cheap transport, an asset which railway electrification does not at present appear to provide.

It is officially announced that the new Underground Station at Piccadilly-circus will be opened at the end of this month. As the work was begun in February, 1925, it will thus have been completed within four years.

Literature.

Reinforced Concrete Bridges. By W. L. Scott, M. Inst. C.E.; assisted by C. W. J. Spicer. London: Crosby Lockwood and Son. Second edition. 1928. Price 25s. net.

It is indicated by the sub-title that this book relates to "the practical design of modern reinforced concrete bridges, including notes on temperature and shrinkage effects," the author thus usefully limiting the scope of his work to the reinforced concrete bridge as a structure, not as the survivor of competing forms in a river crossing problem, nor indeed in comparison generally with bridges built of other materials. The book is, as stated in the preface, intended to amplify the information given in other works, while at the same time covering the special subject in a comprehensive manner. Since, however, he does not discuss problems involving decisions regarding deep or shallow foundations, few or many spans, and like matters, the author is not really entitled to claim, as he does, that the information given comprises all that is essential to guide an engineer in "the adoption" as well as the design of a bridge to suit "any case" ordinarily met with.

Beginning at the author's starting point, the subject demands just such treatment as he gives to it. By the elimination of unimportant matter and by strict economy in the use of available materials, Mr. Scott succeeds in dealing adequately with all the more important aspects of the design of reinforced concrete bridges, sufficiently treating of details such as merit separate attention. Further useful information is supplied by the notes on a considerable number of important bridges, the plates relating to them including views of completed bridges and, very usefully, of bridges under construction and of temporary staging. In the chapter on loading and wind pressure there are diagrams of British and French standard loadings, the loading for a French military convoy, charts of normal relations between lorry capacities and rear wheel loads, and of central shears to spans for railway bridges. American loadings are also discussed. These important elements of design having been duly considered, temperature and shrinkage effects are studied in another chapter. In a chapter on influence lines, the cases of single, two-span, and three-span beams are discussed, with tables giving bending moments, reactions, and shears for positions 0·1 to 1·0. The author's method being thus briefly indicated, in respect of the first part of the book, it will be realised that he has prepared the way for a discussion of the several types and forms of reinforced concrete bridges, his special experience, as indicated by his position as chief engineer, Considère Constructions, Ltd., enabling him to exercise sound judgment as to the space necessary for the discussion of each type. Prominence is given to the hingeless arch, with a fully worked out example for an 80ft. span, and to girder bridges, with similar treatment in the case of a span of 128ft. All the more important details are described, with the help of very good diagrams, and a well-illustrated chapter is devoted to temporary and permanent hinges. Some useful data relating to materials is given in the appendix, in which is included a typical specification for a bridge. In view of the full information supplied in works severally devoted to stone, cement, concrete, and to reinforced concrete as a material, the author's brief treatment of the materials employed in the building of reinforced concrete bridges may be considered sufficient for his purpose.

By concentrating upon that well-defined purpose, Mr. Scott and Mr. Spicer have succeeded in providing the designing engineer and the draughtsman with a really useful guide to the sound design of reinforced concrete bridges, in a volume to the printing and illustration work of which, in respect of both conception and execution, high praise may be accorded.

Letters to an Absentee Director. By John Lee. London: Sir Isaac Pitman and Sons, Ltd. 1928. Price 5s.

It is pleasant to have this series of twenty letters, which graced the columns of the *Times Trade and Engineering Supplement* for many weeks, in book form. Many there were who read them as they were written, but many more will read them now as a book. There is a gentleness, a human-ness in them, which leads one on from the first to the last with its sad little postscript. Mr Lee says in a dedication to an American friend, which takes the place of a preface, that these letters "shrink from being dogmatic." Perhaps they go even a little too far in that direction, for, particularly in the earlier letters, the Junior Director speaks with so much diffidence that he sometimes leaves us wondering about his meaning. Indeed, it is not until the last few pages are reached that we are quite sure whither his thoughts are tending. It is as though one should start meandering through the mists of the morning and by degrees find himself in a sunlit lane opening on to a broad highway. Mr. Lee is clearly as full of sympathy with workers as with employers, and desires to see them acting in harmony; but, if we have caught his message aright, he believes that the movement towards a complete *rapprochement* must be inspired by the workers themselves; that it cannot come as an Act of Parliament, probably not even through "machinery" set up by employers, but must result from the workers' own desire to understand and share the anxieties and responsibilities connected with industry. "We are coming to the new era when the workmen have their ideas, when they can articulate them, when they can put them into their proper balance, when they can feel that there is a greater sense of pride and of realisation in achievement than in acquisition." Mr. Lee is plainly an individualist, and we may guess that he is no advocate of State action, believing that better results are to be attained in the long run by mutual understanding and mutual sympathy than by rules and regulations.

We do not deal with the various questions discussed in a gentle way in the letters. It is rather by its whole than by its details that the book must be judged; what shall one know of a melody by examining separate notes?

SHORT NOTICES.

The Hydro-electric Power Commission of Ontario: Its Origin, Administration and Achievements. Toronto. 1928. —In the work of water power development in Canada the Ontario Commission has played and is playing a part which it would be difficult to overrate. It has several great power stations to its credit, but if it had none other than the wonderful station and its ancillary works at Queenston, its reputation would have been made. It is entrusted with the duty of supplying Ontario with electricity at the lowest possible economic cost and has been providing electric energy since 1910. It is entirely free from political influence. It began by purchasing from the Ontario Power Company at Niagara power which, with its own transmission lines and transformer stations, it delivered to twelve municipalities. Five years later the consumers numbered 130. In 1925 they had mounted to 436, and in this year, 1928, the Commission is supplying electrical energy to about 550 municipalities, of which 325 are urban—including 25 cities and 84 towns—and 225 are townships. By the end of 1915 the 100,000 horse-power which could be taken from the Ontario Power Company became insufficient, and other sources of supply were found for 75,000 horse-power. In 1917 the Ontario Power Company was purchased—and the plant extended—and in 1920 the Toronto Power Company was also bought. In that year the load was 350,000 horse-power. As the demand continued to increase powers were obtained for the construction of the Queenston-Chippawa station, which began to send out current in 1922, and three years later was delivering 550,000 horse-power. Altogether the Commission is distributing more than 1,000,000 horse-power derived from twenty-two hydro-electric plants and has now made provision for a total supply of 1,400,000 horse-power. These few facts and figures are taken from the little book whose title is given above. We may add that the book contains as well many notes on the supply and use of electricity in Ontario, and some excellent illustrations with brief descriptions of the power-houses. As a source of general information about the "Hydro," as it is familiarly called in Ontario, we welcome it.

The Recovery and Use of Industrial Wastes. By J. B. C. Kershaw. London: E. Benn. 1928. 25s.—The subject matter of this book is interesting, even to Englishmen with their habit of throwing away anything which is not immediately wanted, and should be arresting to French people, on account of their habit of collecting and classifying all waste material. There is, nevertheless, a growing tendency towards economy of the kind in this country, and Mr. Kershaw shows how it may be effected in many directions, ranging from chemical works, through engineering shops, mines, paper works, municipal depôts, sugar mills, tan yards, rubber works and so forth, to the land, where wood and other vegetable wastes accumulate. In some cases perhaps the author's ideas are rather visionary, when, for instance, he suggests the collection of used safety razor blades and their melting down in local electrically heated furnaces. Nevertheless, his thoroughness may be gauged from the fact that he considers the influence of the price of scrap rubber on international politics, and his description of a by-product plant, using wood refuse, which paid for itself within three years. It is a good book, and will probably be elaborated.

BOOKS RECEIVED.

Administration Report of the Aden Port Trust for 1927–1928. Aden: Port Trust Office.

City of Liverpool, Report of the Water Engineer for the Twelve Months ending March 31st. Liverpool: Published by the Corporation.

Workshop Practice. Part I. Edited by E. A. Atkins. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 1s. net.

The Geology of Petroleum and Natural Gas. By E. R. Lilley, Sc.D. London: Chapman and Hall, Ltd., 11, Henrietta-street, W.C. 2. Price 30s. net.

The Theory of Film Lubrication. By R. O. Boswell. London: Longmans, Green and Co., Ltd., 39, Paternoster-row, E.C. 4. Price 12s. 6d. net.

Quarterly Bulletin of the Institution of Engineers, Australia. Volume V., No. 19. Sydney: The Institution of Engineers, Australia, 16, College-street.

The Graphic System of Calculating Rates and Freight Charges. By T. Martin Jones. Calcutta: Government of India Central Publication Branch. Price 10d. net.

Electrical Transmission and Distribution. Part I. Edited by R. O. Kapp. London: Sir Isaac Pitman and Sons, Ltd., Parker-street, Kingsway, W.C. 2. Price 1s. net.

Annali dei Lavori Pubblici (gia Giornale del Genio Civile), Ministero dei Lavori Pubblici, Consiglio Superiore. Luglio, 1928. Rome: Provveditorato Generale dello Stato Libreria. 1928.

COVENTRY CORPORATION ELECTRICITY SUPPLY—LONGFORD POWER STATION

MR. GEO. TOUGH, M.I.E.E., COVENTRY, ENGINEER

(For description see opposite page)

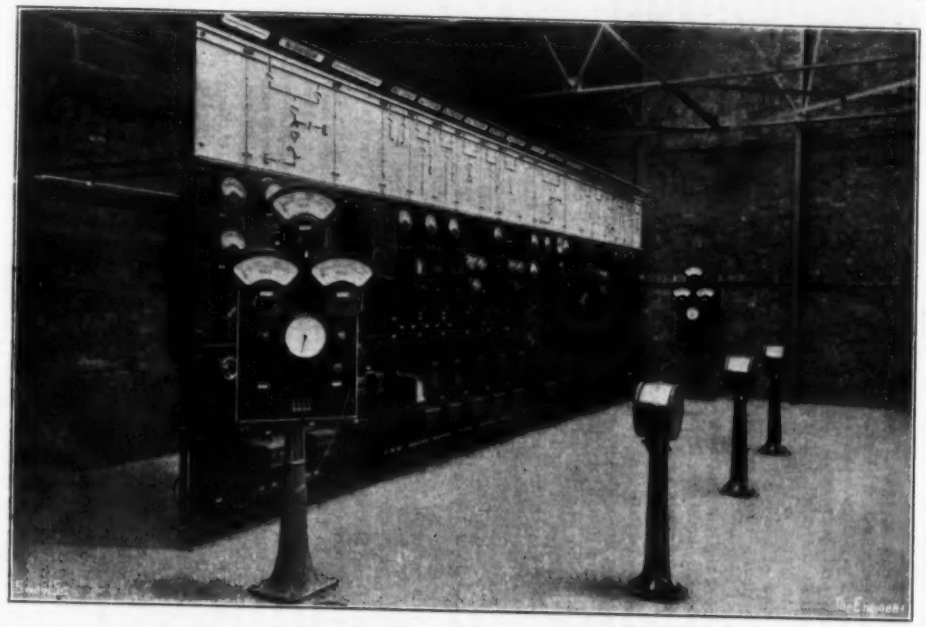

FIG. 11—33,000-VOLT CONTROL BOARD

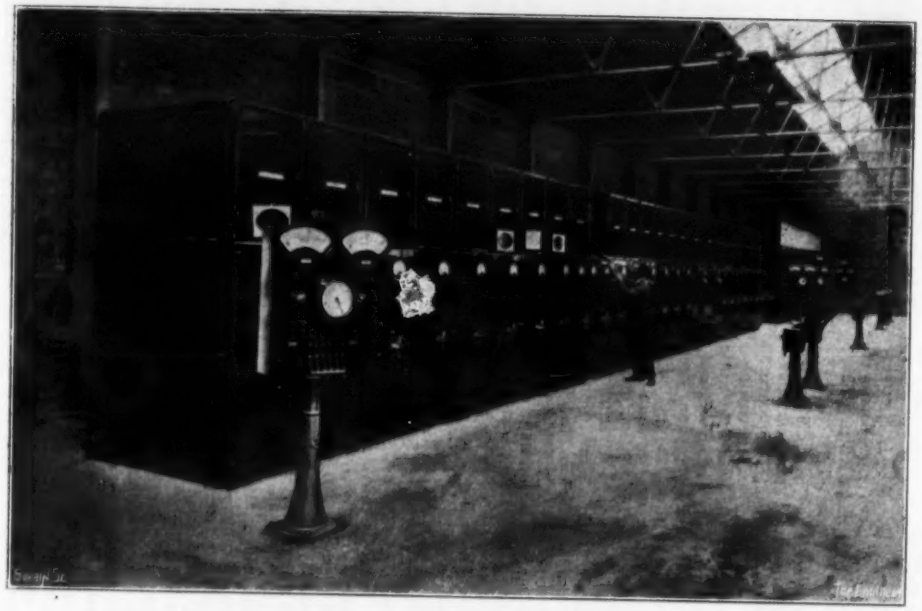

FIG. 12—420-VOLT CONTROL BOARD

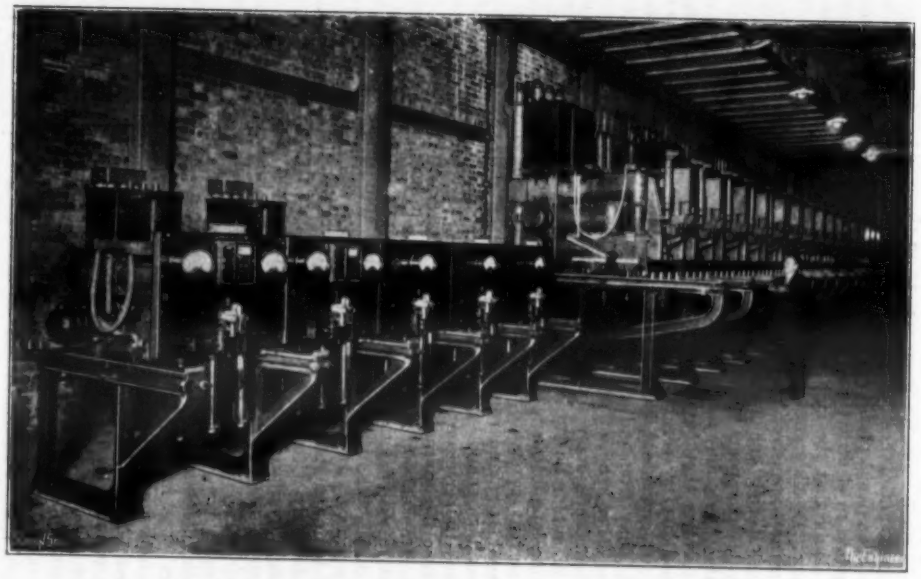

FIG. 13—6,600 AND 33,000-VOLT METAL-CLAD SWITCHGEAR

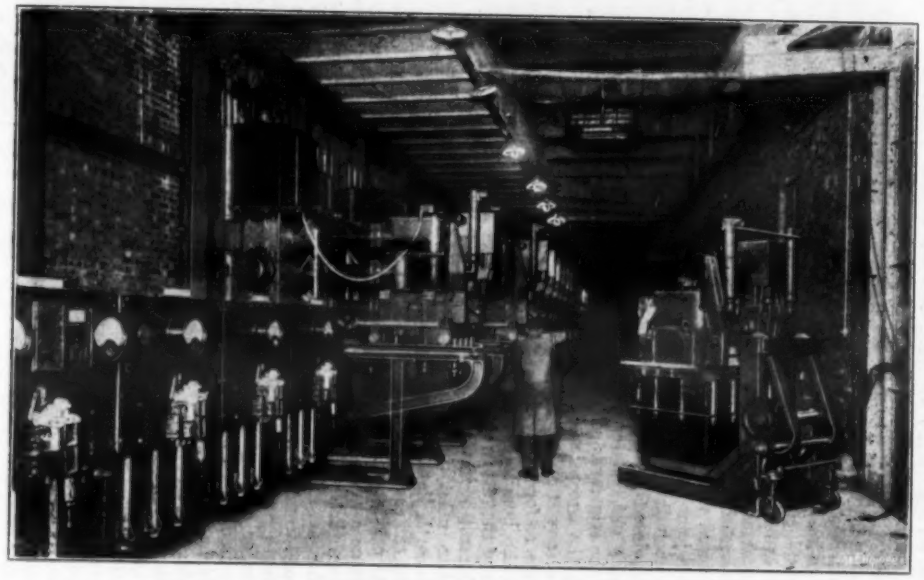

FIG. 14—33,000-VOLT TRUCK WITHDRAWN

Coventry Corporation's Longford Power Station.

No. II. (*Conclusion*).*

EACH of the turbines is coupled to a main alternator, house service alternator, and a main and auxiliary exciter, all running at a speed of 3000 revolutions per minute. The main 6600-volt 50-cycle alternator of each set is directly connected to a main transformer bank which feeds various sub-stations at a pressure of 33,000 volts, and all switching operations are carried out at this pressure. Each machine is designed to provide the magnetising current for its step-up transformers and to maintain 18,750 kW at 0·8 power factor on the transmission lines. They will develop 25,300 kVA at 0·74 power factor with a temperature rise not exceeding that prescribed by the British Engineering Standards Association, namely, 80 deg. Cent. on the stator coils as measured by embedded temperature detectors, and 90 deg. Cent. on the rotor windings as measured by resistance. Fans attached to the ends of the rotors serve for ventilating the machines on the closed system, and the air is cooled in B.T.H. coolers. In order to simplify the design of the stator windings phase leads have been brought out at each end of the machine and half the load current is carried by each set of leads.

Each of the three-phase, 50-cycle, 420-volt auxiliary alternators is rated at 714 kVA at 0·7 power factor and is capable of supplying the boiler-house and turbine auxiliaries. The main exciter, which is rated at 60 kW, excites the main alternator under all conditions of load, and it derives its excitation from the auxiliary exciter which is rated at 13·5 kW. As the auxiliary exciter is a shunt-wound machine with a saturated magnetic circuit it operates at constant voltage. The only rheostat in the main alternator excitation circuit is controlled by a Tirrill voltage regulator for maintaining the main bus-bar voltage constant. By providing separate excitation for the main exciter perfectly stable operation of the main alternator is ensured at all loads. The auxiliary exciter also excites the house service alternator, and in this case a hand-operated rheostat is included in the circuit as close voltage regulation in this instance is unnecessary. The electrical connections for the machines are shown in Fig. 17, whilst Fig. 16 shows the main and auxiliary connections for the station.

Underneath the switchgear control gallery—see Fig. 11 on page 522—which is on the west side of the turbine room, all the main switchgear is placed, whilst on the other side of the west wall there are two banks of three B.T.H. single-phase transformers—see Fig. 15—which are of the "air jet" self-cooled outdoor type, and are said to be the largest transformers of this type in use in this country. They were described in THE ENGINEER of April 27th, 1928. On the low-tension side the units are connected in delta and in star on the high-tension side. The ratio is 6600/33,000 volts and the full-load output per bank is 23,475 kVA at 0·8 power factor. Each bank of transformers has an oil conservator, and a pressure relief pipe with a glass diaphragm is fitted to each unit, so that in the event of excess pressure occurring in the tank the diaphragm will break. There are also valves for testing, treating and conditioning the oil, and indicating and recording thermometers, &c. To facilitate moving a transformer when on the ground the undercarriage is fitted with rollers and draw eyes and the station equipment includes a rail transfer truck, by means of which a transformer unit can readily be removed from its bank and a spare unit kept in the turbine room can be brought out and connected in circuit in a very short space of time.

Inspection and overhaul of a unit can therefore be carried out in the engine-room. Besides these main transformers there are two self-cooled house service three-phase units with a ratio of 33,000/420 volts. These transformers are also to be seen in Fig. 15.

The main 33,000-volt metal-clad compound filled electrically-operated switchgear is shown in Figs. 13 and 14 on page 522. It is constructed on the duplicate bus-bar principle, and in addition to the circuit equipments it is provided with bus section and bus coupling equipments with provision for installing bus-bar reactances when extensions are made. The fixed unit of each equipment consists of a circuit connection chamber supported by the top bus-bar chamber, whilst the movable unit, which is mounted on rollers and which is racked into or out of the service position by a hand-operated screw mechanism, carries the oil-immersed circuit breaker and the instrument and protective transformers. Voltage transformers are mounted in an accessible position on top of the fixed units, and primary cut-outs are accommodated in the transformer tanks. Isolation of a voltage transformer and cut-outs can be effected without interruption of the main circuit, for when withdrawing the connectors the initial break occurs on the transformer side, so that the magnetising current is interrupted under oil. Access to a transformer cannot be obtained until the connections have been withdrawn. The metal casing of each connector is earthed, while the latter is in circuit and also throughout the withdrawing operation, and when it is fully withdrawn the contact receptacle in the circuit connection chamber is automatically covered by a shutter which can be locked.

An interlocking mechanism operated by the bus-bar isolating plugs on the movable units enables an indication to be given on the control board of the set of bus-bars to which a circuit breaker is connected. For this purpose auxiliary contacts are fitted on the automatic bus-bar shutters. This interlocking mechanism is also arranged so that it is impossible to synchronise an equipment unless all three bus-bar isolating plugs are connected to the same set of bus-bars. The interlock makes it impossible to close a breaker with the plugs connecting with bus-bars of both sets.

The main circuit breakers are designed for a rupturing capacity of 500,000 kVA at 33,000 volts, and all three phases are enclosed in an insulated oil tank. The phases are separated by insulated metal phase barriers which eliminate risk of breakdown between the phases. The pressure set up by the gases generated when a circuit breaker operates under a heavy fault is relieved by separating chambers filled with pebbles and by gas vents. As the cast steel top plate of the breakers is of a deep box section adequate space is provided for gas expansion, and the pressure rise in the breaker on the occurrence of a fault is to a large extent restricted. The breaker contacts are of the self-aligning finger type reinforced by strong backing springs and are fitted with renewable sparking tips. These contacts engage with wedge-shaped copper blades and powerful accelerating springs ensure the correct speed of break, whilst the shock at the end of the opening stroke is absorbed by a self-contained system of dashpots. The control board shown in Fig. 11 on page 522 is composed of black enamelled slate and has white enamelled slate indicating panels mounted above it. Outlined in black on these indicating panels is a single-line key diagram of the 33,000-volt bus-bars and of the various circuits controlled, whilst automatic electrically operated indicators show which circuit breakers are "open" and which are "closed." The turbo-alternators are provided with the B.T.H. Company's system of circulating current protection, combined with field suppression switches and stand-by time limit overload and leakage relays. The machines are therefore protected against damage due to internal faults and sustained external faults. The house service transformers are similarly protected by a circulating current protective system combined with stand-by overload protection, whilst the 33,000-volt feeders have the B.T.H. system of self-compensating pilot wire protection.

Alongside the 33,000-volt switchgear is a bank of 6600-volt compound-filled metal-clad switchgear, which controls the 6600-volt side of two 3000-kVA 33,000-volt step-down transformers, and three outgoing feeders to the existing 6600-volt system. This switchgear is of single bus-bar construction and the oil-immersed circuit breakers are hand controlled.

FIG. 15 SELF-COOLED OUT-DOOR TRANSFORMERS

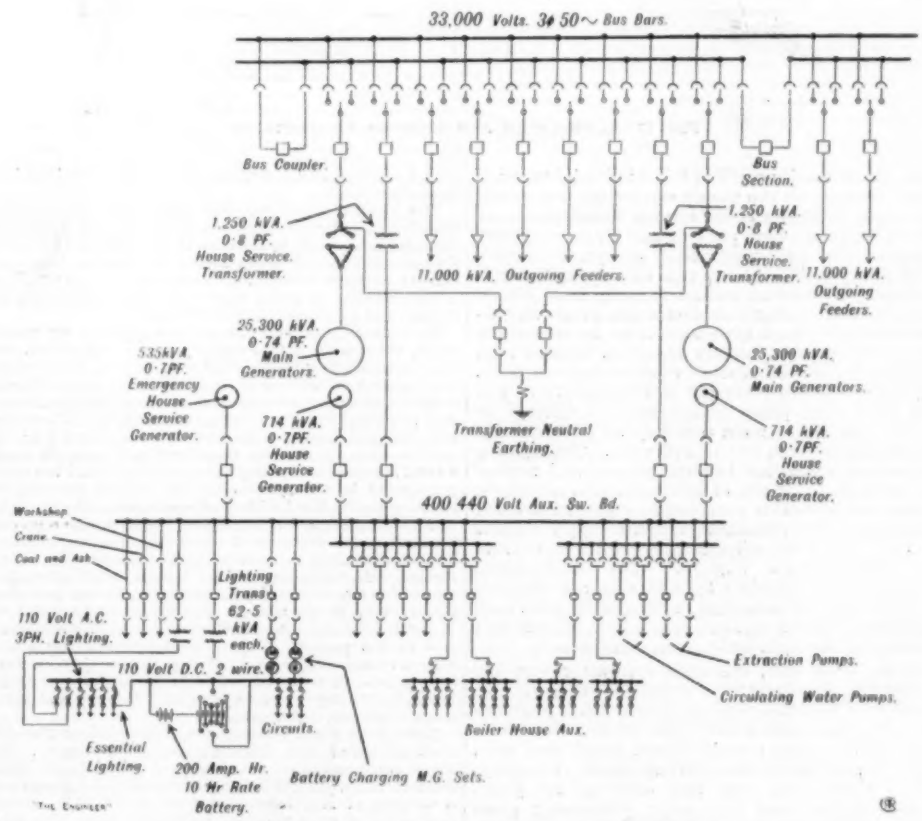
33,000 Volts. 3φ 50~ Bus Bars.
Bus Coupler.
Bus Section.
1,250 kVA. 0·8 PF. House Service. Transformer.
11,000 kVA. Outgoing Feeders.
1,250 kVA. 0·8 PF. House Service. Trunaformer.
11,000 kVA. Outgoing Feeders.
25,300 kVA. 0·74 PF. Main Generators.
535kVA 0·7PF. Emergency House Service Generator.
714 kVA. 0·7PF. House Service Generator.
Transformer Neutral Earthing.
25,300 kVA. 0·74 PF. Main Generators.
714 kVA. 0·7PF. House Service Generator.
400 440 Volt Aux. Sw. Bd.
Workshop
Crane
Coal and Ash
Lighting Trans 62·5 kVA each.
110 Volt A.C. 3PH. Lighting.
110 Volt D.C. 2 wire.
Extraction Pumps.
Circulating Water Pumps.
Circuits.
Boiler House Aux.
Essential Lighting.
200 Amp. Hr. 10 Hr Rate Battery.
Battery Charging M.G. Sets.

FIG. 16—MAIN AND AUXILIARY ELECTRICAL CONNECTIONS

* No. I. appeared November 2nd.

A 420-volt, three-phase, 50-cycle, 25-panel black enamelled slate switchboard—Fig. 15, page 522—has been installed to control the station auxiliaries. It is situated on the same gallery as the main control board for the 33,000-volt switchgear, and receives its supply from the house service transformers. The 714-kVA house service alternators are connected to alternative bus-bars for the boiler-house and turbine auxiliaries, this latter supply being in two sections, so that each turbo-alternator set will supply its own auxiliaries and one set will not be affected by the shutting down of the other.

An emergency house service alternator can be synchronised with the station transformers to facilitate starting up the station after both sets have been shut down. The two sets of bus-bars are mounted one above the other and are divided off by horizontal screens. Above, and in line with the switchboard panels, are hinged expanded metal doors which give access to the pole-operated isolators. Each door is normally locked and the key is locked in the corresponding circuit breaker operating escutcheon. This key can only be removed when the breaker is in the "off" position, and the breaker cannot be closed until the key is re-inserted in the escutcheon. It is therefore impossible to make or break a circuit on the isolating switches. The switchboard is divided at the back into vertical and horizontal compartments by sheet steel screens so that inspection and cleaning can be effected without risk of accidental contact with live parts. As the top of the switchboard is entirely covered by expanding metal screens it is completely enclosed, so that only authorised persons can gain access to any compartment at the back.

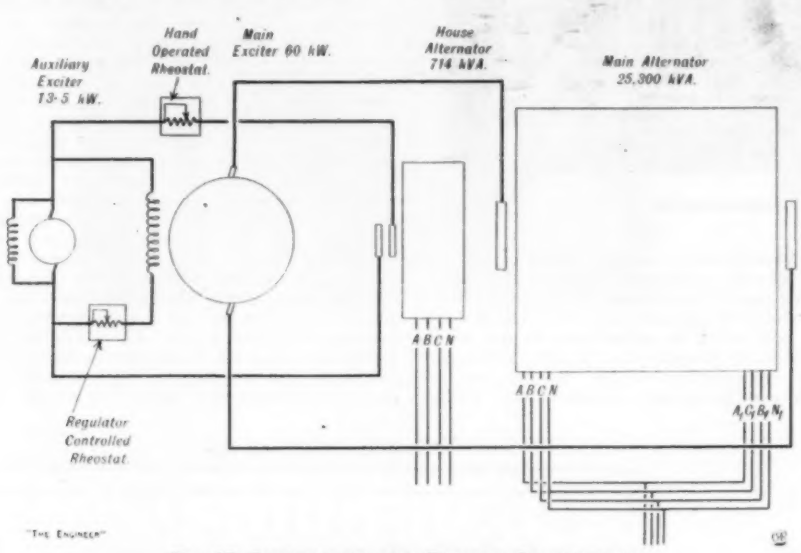

FIG. 17—ALTERNATOR AND EXCITER CONNECTIONS

The direct hand-controlled triple-pole oil-immersed circuit breakers on the panels controlling the incoming supply from the house service transformers are provided with one tank per pole and are rated at 2500 ampères. The remaining panels are provided with direct hand-controlled triple-pole oil-immersed circuit breakers with current ratings ranging from 300 to 1600 ampères. A small black enamelled slate switchboard of the flat back type is provided for controlling the station lighting, battery charging, breaker solenoid circuits, and other small direct-current supplies. The station lighting current is obtained from two 62·5 kVA three-phase transformers, connected to the bus-bars of the main auxiliary switchboard and stepping down from 420 to 190 volts. The lighting circuits are connected between phases and neutral and work at a pressure of 110 volts. An automatic change-over switch is provided so that in the event of failure of the alternating-current supply various essential lights are automatically switched over to the direct-current battery. The boiler-house auxiliaries are controlled by four separate banks of ironclad draw-out industrial pattern switchgear, each tank being fed by a separate feeder from the 420-volt bus-bars on the main low-tension switchboard.

As we have said, the main contractor was the British Thomson-Houston Company, of Rugby. The principal sub-contractors are given below:—Buildings, the Cleveland Bridge and Engineering Company, Ltd.; cooling towers, Wilson Lovatt and Sons, Ltd.; boiler plant, the Stirling Boiler Company, Ltd.; stokers and coal and ash-handling plant, Edward Bennis and Co., Ltd.; condensing plant and evaporators, tanks, &c., Worthington-Simpson, Ltd.; cables, Johnson and Phillips, Ltd., and Pirelli-General Cable Work, Ltd.; lighting installation, Lee Beesley and Co.; crane, Herbert Morris, Ltd.; pipework, Aiton and Co., Ltd., and Stewarts and Lloyds, Ltd.

The turbo-alternators, switchgear, transformers, auxiliary motors, and control gear, and the lamps and lighting fittings were supplied by the British Thomson-Houston Company, Ltd.

An Up-to-date Cotton Mill Power Plant.

In view of the importance of cheap power for industrial purposes and the tendency on the part of power users to resort to public supplies, the paper which Mr. A. B. Mallinson, M.I. Mech. E., M.I.E.E., read before a joint meeting of the North-Western Branches of the Institutions of Mechanical and Electrical Engineers, held in Manchester on Thursday, November 1st, came at an appropriate time, and the interest which the paper aroused was demonstrated by the large attendance of members as well as by the discussion that the subject evoked. Professor W. H. Watkinson, Chairman of the North-Western Branch of the Institution of Mechanical Engineers, under whose ægis the paper was given, presided. The paper comprised a detailed description of a very comprehensive mill power reorganisation scheme which the author has carried out at a group of four cotton mills at West Leigh, Lancashire. The machinery in these mills comprises 192,568 mule spindles and 26,272 ring spindles, as well as beaming and reeling frames. Formerly each mill was separately driven by reciprocating condensing engines, which were supplied with steam from Lancashire boilers, the average weekly coal consumptions being 253 tons in the summer and 275 tons in the winter. The coal consumption, including that used for heating the mills, came out at 3·3 lb. per indicated horse-power. After considering various schemes, it was decided to reorganise on the following lines:—To install a central steam-raising plant to supply all the mills, Nos. 1, 2 and 3 being electrified, and driven by a 2000-kilowatt turbo-generator, while in No. 4 mill the old engine drive was retained and steamed from a new water-tube high-pressure boiler through a reducing valve and de-superheater. Eventually this mill will either be driven from a separate steam turbine with a mechanical drive or the mill will be electrified from the public supply.

The possibilities of running on a public supply were considered, but were abandoned because (*a*) it was not intended in any case to electrify all the mills at that time; (*b*) centralisation of steam raising on modern lines indicated a substantial return on the outlay; (*c*) at that time it was difficult to get a supply and the price asked for current was considered excessively high.

To replace the several obsolete power plants one central plant, comprising a thoroughly modern equipment, was adopted, including three water-tube boilers, each capable of evaporating 27,000 lb. of water per hour, two only being installed up to the present. The boilers are fitted with coal and ash-handling plant, economisers, Babcock's stokers and Lea coal meters. The feed water is taken from the mill cooling ponds after treatment and analysis shows a total hardness of 4·6 deg. As practically half the water evaporated in the new boilers has to pass through the existing engine fitted with a jet condenser a closed circuit was not feasible, and the new plant is fitted with a jet condenser from the discharge of which the boiler feed is drawn. The exhaust from the turbine feed pump goes direct into the hot well, while the exhaust from a 70-kW generating set, which supplies turbo-generator excitation and plant power, and a 15-kW pilot set and plunger pump, which run at night, discharge into a feed-water heater on the delivery side of the pumps. Typical feed temperatures are as follows:—Air temperature, 60 deg. Fah.; injection water from ponds, 78 deg.; turbo-condenser discharge, 90 deg.; hot well, 130 deg.; economiser inlet, 160 deg.; and economiser discharge, 265 deg.

The power plant comprises a Metro-Vickers 2000-kW turbo-generator with Hicks-Breguet jet condenser. The steam consumption of this set at ·8 power factor varies from 11·56 lb. per kW hour when working at full load with a vacuum of 28¼, barometer 30in. to 12·38 lb. at half load, with vacuum 28·87in., barometer 30in. The alternator, fitted with Merz Price balanced protective gear, is cooled on the closed circuit system, the water for cooling being drawn from the condenser system. In actual operation the load on the set is 2200 volts, 575 ampères, ·84 power factor, full-load rating being 657 ampères, ·8 power factor. In the power-house are also placed two Belliss and Morcom compound engines, one of 70 kW driving a 20-kW exciter for the turbine, and 50 kW, 225 volts D.C. generator for power plant, mechanics' and joiners' shop motors and lighting. A further 120-kW engine is coupled to the old lighting dynamo and operates condensing as a standby for mill lighting.

Along the whole width of the house is the main switchboard for motor control and the auxiliary gears, whilst in the basement are a 200-kVA transformer for stepping down to 400 volts for sundry smaller motors and lighting, and two auto-transformers, each being suitable for starting a 350 H.P. motor three times in one hour.

Cooling System.—The turbo-condenser draws from a jack well through a 16in. cast iron pipe, and is returned along a 14in. pipe. Cooling is effected by delivering the discharge into a reservoir and feeding through two other reservoirs back to the jack well, the capacity of these reservoirs being 4,900,000 gallons. The temperature drop across the ponds averages 12 deg. Fah. The cooling system for the No. 4 mill engine and standby lighting generator is kept separate to avoid possible boiler troubles from oil, two further reservoirs forming the cooling ponds.

No. 4 Mill Engine.—A 10in. jointless main is carried across a 55ft. bridge to this mill. The engine when built was designed for 80 lb. saturated steam, but the pressure had been increased to 120 lb. The engine is a twin horizontal compound, 26in. and 40in. by 6ft. stroke, 45 revolutions, fitted with Corliss valves and Hicks-Breguet condenser. The particular item of interest here is the manner in which the engine is now steamed from the boilers at 275 lb. pressure with 245 deg. Fah. of superheat.

A 4in. Arca reducing valve first reduces the pressure to 120 lb. and the temperature of the steam is then reduced to the required value—about 35 deg. to 40 deg. of superheat is lost in the pipe line—in an Arca de-superheater. The Arca controls are operated by water at 18 lb. pressure, an existing 6000 gallons tank in No. 2 mill being utilised. Tank supplies are taken normally from the condenser system by a 1 H.P. "Mo pump," and if the tank falls to half full, a ball tap admits Corporation water. The discharges from the control valves are returned to the hot well. In practice, this control has been found to be most effective. No difficulty has been found in spinning fine counts.

Mill Heating.—This is done through the existing pipe lines at 120 lb. pressure, the condensate being brought back to the hot well. Generally it is carried out through the night, excepting for certain of the card rooms which require heating through the twenty-four hours.

Electrical Equipment.—The electric driving of Nos. 1, 2 and 3 mills has been carried out on the group system, one or two large motors being installed for each floor. The reasons for adopting this as against individual driving were (*a*) the whole of the spinning machines must be continuously operating during working hours; (*b*) the millwrighting for each room as operating from the engine drive was all modern and in first-class condition; (*c*) the initial cost of the individual drive would have been much greater; (*d*) it enabled the change over to be attained with the minimum loss of spinning time; (*e*) by reason of the system of control installed 100 per cent. of running time can be attained, since all rooms start and stop under the control of one man and are not dependent on the individual machine tenters.

Particulars of interest are:—(*a*) System of control; (*b*) position of motors and method of driving; (*c*) motor ventilation.

(*a*) *System of Control.*—All the motors are squirrel-cage type, connected right through to the main control switchboard, without the usual starter for each motor, and the whole of the switches on generator or motor circuits are in normal operation always in the closed position. The central control board, some 42ft. long by 12ft. 6in. high, is of the boiler plate cubicle type with back access, each cubicle having an interlocked isolating switch. The starting and stopping is effected solely by the stop valve of the turbo-generator. The alternator is separately excited by the engine-driven pilot set, which set also provides—from a separate dynamo—the necessary D.C. power for all the power plant motors and light. As soon as the turbine speed gets sufficient to overcome the starting torque, the motors start creeping round, and run up in step with the turbine without putting an overload on the turbo-generator.

New Motors.—Eleven motors were installed, comprising four 150 H.P., four 275 H.P., three 350 H.P., all running at 428·6 r.p.m. synchronous.

(*b*) *Position of Motors and Method of Driving.*—In only one case—No. 1 card room—is a motor in a spinning room, and there it is placed on a steel platform out of reach. The old vertical engine-houses and rope races have been utilised for the drives; in every case the drive from the motor to the line shaft is through a coupling on to a two-bearing jack shaft, and from jackshaft to line shaft by "Manneck" square ropes. The couplings for the spinning-rooms are flexible pin type, and for the card-rooms Broadbent slip clutches. Rope drives rather than direct coupling were adopted to simplify the change-over, to avoid cutting large holes for motors into the existing walls, and to enable spindle speeds to be altered if required by any new developments in spinning, by simply changing one pulley.

(*c*) *Motor Ventilation.*—All motors are fitted with Visco oil film filters, thereby ensuring clean ventilation passages and no overheating with use. The large motors all have a separate belt-driven fan bolted to the machine frame to provide effective ventilation. Where the surroundings are hot or dusty the ventilation ducts are carried to the outside air.

The air filters have a resistance clean of 5 mm. rising up to 8/10 mm. of water, depending on the state of the filter. Operating experience of these filters has been most satisfactory. The filter runs for two to six weeks before it requires cleaning, depending on the position. Cleaning is a simple matter. The filter is first dipped in hot water with soda, and the sticky oil film with the dirt washed off. The filter is then dipped in the oil bath, and after draining off is ready for use.

Operating Results.—Prior to the change over the mills operated on 3·3 lb. of coal per indicated horse-power, including mill heating. This is now reduced to 1·66 lb., the weekly coal bill being reduced from 253 to 155 tons—a saving of over 38 per cent. on previous summer consumption.

The cost per unit generated over six months' running, including all labour operating costs, coal for heating, power plant maintenance, and insurance, is ·304d. per unit, or including 10 per cent. for interest and depreciation on the outlay on power plant, ·498d., which, bearing in mind that

mill heating must still be provided for if power were bought, is a low figure.

Other advantages which have accrued from the change-over are:—(1) Freedom from black smoke; a most important factor, seeing that the area around the mills is densely populated. (2) Two stacks and one large engine-house have been pulled down, thereby greatly improving the natural lighting of the mills. (3) It has enabled further productive machinery to be installed, including the conversion of No. 4 mill, containing 85,000 spindles, to a combing mill, by utilising the old boiler-house, &c., without any extensions of buildings. (4) A distinct increase in production from the existing equipment.

Discussion.

In the discussion which followed the reading of the paper a number of members took part. Mr. D. Adamson opened by asking the author why he had installed water-tube boilers, as there were no sudden calls for steam in a cotton mill, such as in an electric power station.

Mr. Irwin, the next speaker, who had some experience with the plant, said with reference to Mr. Adamson's remarks that when the mills started up in the morning and after midday there was a sudden demand, and at those times the production of black smoke had to be avoided. The water-tube boiler showed to advantage then.

Mr. A. Saxon asked whether the owners of the mills had considered driving the three mills from one up-to-date steam engine with rope driving. That system had been carried out successfully at a mill in Ashton-under-Lyne. With regard to the steam engines replaced in the author's scheme, Mr. Saxon did not consider them an average example. He gave particulars of the consumption of five mills, all on adjacent plots, the coal consumptions of which were 1·9 lb., 2·26 lb., 2·04 lb., 2·17 lb., and 2·12 lb. of coal per indicated horse-power. None of these engines was under twenty years old. With regard to bringing engines up to date, a pair of tandem compound engines installed in a mill at Oldham in 1884 to work at 100 lb. pressure had been altered into cross-compound with new boilers, and a saving of 36 per cent. had been effected. The steaming of cotton mills and the banking of fires were often lost sight of. Cotton mills worked forty-eight hours per week and were standing 120 hours, but the mill-rooms had to be kept warm. The capital cost of the scheme the author had described would be beyond the means of many firms at the present time, and for that reason firms had resorted to public supply companies and the running costs were most expensive.

Mr. Fennell said the author's paper was one of the best advertisements for the electric supply companies. The author had not given the capital cost, but without providing any standby of any description and with only one steam turbine, the cost of current was ½d. per unit. He said that in Oldham they could buy current at something like that price.

Mr. W. Bayliss said Mr. Mallinson had given them a steam consumption of 11·56 lb. per kW hour, or approximately 9 lb. per brake horse-power, and he would like to know if there was any steam engine in any mill that was operating on that consumption.

Mr. W. Rhodes spoke about the running conditions in the West Leigh mills, and said the steadiness of drive was remarkable, and from the production point of view the alterations made were justified.

Mr. J. Hetherington said he noticed that each line shaft had a separate motor. Would it not have been better to have introduced one large motor and to have driven the several line shafts from the different floors. A mixed drive would have cut out an amount of electrical expense. He had been interested in several similar schemes, and in one plant of 1500 horse-power the boilers and turbine plant were maintained by one attendant.

Mr. J. E. Johnson said the coal consumption of 3·3 lb. per brake horse-power savoured of Mr. Heath Robinson. It was ridiculous, and he found it difficult to reconcile that with the statement that the old plant had always been maintained in excellent order. The boiler plants seemed to have had a very easy time in the old plant. He asked whether the figures given for the new plant included the cost of carriage of coal to the mills and the removal of ash.

Mr. H. L. Guy called attention to the steam consumption of 9 lb. mentioned in the paper. He said that was the maximum rate and actually the steam consumption at the turbine coupling was 8 lb. per brake horse-power. He also pointed out that the steam conditions were not those given in the paper. The conditions at the turbine were some 25 lb. lower and 25 deg. to 50 deg. lower temperature.

The Cost of Noise.*

American workmen seem to be deaf to industrial noises; it might almost be said that Americans are deafened by industrial noises. The roar of rapid and powerful machinery, the clanking of hammers and presses, the grinding of gears—still with us—the puffing of engines and the whistling of exhausts, the ringing of bells and shrieking of sirens—all rise into a crescendo so characteristic of industrialism that the modernist composes "music" to its rhythm. We tolerate this bedlam despite the fact that we all avoid mechanical noises in the home, and pay premiums for silent vacuum sweepers, refrigerators and household appliances, and judge a motor car by its quiet passing. Even though we search for economies in manufacture, we endure violent noises, every one of which represents waste. Would not an efficiency engineer be lost in a factory, which though busy was quiet?

Perhaps the construction operations in our big cities are no guiltier than other branches of industry elsewhere, but they do seem to proceed with utmost disregard for ear drums—and some of it seems avoidable. Popular opinion and local ordinances have long since demanded mufflers on gas engines, yet an excavator thinks nothing of parking an air compressor alongside the curb, cranking it up, and when it is not blowing off into the throbbing atmosphere, it is pumping air into pneumatic concrete breakers peppering away like so many machine guns.

Such unnecessary noise is doubtless costly. Street railways, which have been constant offenders, are beginning to realise this. For instance car noises in San Francisco are being reduced by more precisely cut gear teeth, and the amplification of such clatter as yet remains is prevented by lead rings inside the gears, sound-absorbing fabric in the car floors, and rubber pads between trucks, bolsters and bodies. Crossings are made of one-piece steel castings, and the wheels ride over on their flanges. This prevents battering at the slots cut in the rail heads; noise is further reduced by imbedding the entire track lay-out in solid asphalt. The public service company reports that this type of crossing not only prevents resonance from the pavement, and avoids shocks passing through to adjacent buildings, but also is much more economical to maintain and presents a smoother roadway for other vehicles. It is also to be expected that less noisy vibration in the rolling stock will result in lower repair bills.

The cost of construction rackets in big cities is less easy to estimate. But if anyone thinks it is of no importance, let him ask a hotel proprietor alongside an extensive building operation! At the American Welding Society meeting recently it was stated that at least fifty rooms in a Philadelphia hotel had been practically uninhabitable for nearly a year on account of the noises from adjacent subway and building construction. This represents a loss of approximately 100,000 dollars income to this one proprietor!

Silent construction is emphasised for welded structural steel erection. For example, a twelve-storey hotel at Hot Springs, Ark., was built between two similar structures without the resounding clatter of riveting guns, and the extra cost of 8 dollars per ton was undoubtedly justified. The erector said the only improvements he could now suggest would be quiet gears on the hoists and lead faces on the erectors' mauls!

Our philosophy is that the best is always cheapest. If welded erection is really a better method from an engineering and constructor's view-point, it will before long be demonstrated to cost less than the noise we have accepted for so long as a necessary evil. In such an event the structural trades will adopt welding as a matter of course. But even if welding should always cost more, there will be many places where the silent method will be demanded by a harassed community, despite the extra. It would not be the first time that the value of public convenience and well being has overshadowed minor financial considerations, and hastened the adoption of some revolutionary proposal.

* From *Iron Age*, New York.

Electric Pumping Plant for Storm Water at Nuneaton.

In 1921 the Ministry of Health approved a scheme for the main sewerage of the borough of Nuneaton, in connection with which it was necessary to construct a storm-water pumping station to relieve the main sewers in case of emergency. The only alternative to a pumping station was the construction of a culvert, 3 miles long, along the valley of the river Anker, discharging at a point somewhere near Mancetter; but the construction of this culvert could only have been carried out at enormous cost.

It was accordingly decided by the borough surveyor, Mr. R. C. Moon, and Mr. S. Cameron Gibson, the borough electrical engineer, both of whom were jointly responsible for the carrying out of the scheme, that the construction of a storm-water pumping station should be proceeded with, and that the pumps should be electrically driven. The capacity of the pumps had to be such that the sewers would be relieved of all storm water over three times the dry-weather flow. This involved a pumping plant capable of dealing with 3486 cubic feet per minute. The following table gives details of the pumps:—

Size, inches	12	20	6
B.H.P.	45	120	25
Revolutions	720	580	1300
Capacity, cub. feet per min.	448	1295	112
Gallons	2742	8100	700
Total head, feet	35	32	35

The pumps were built by Gwynnes, of Hammersmith, while the electric motors, high-tension and low-tension switchgear, and motor control gear were manufactured and supplied by the General Electric Company, Ltd. The station consists of a 34ft. deep pump chamber for the centrifugal pumps, a sub-station, and a superstructure of brickwork and masonry, the general contractors for the building work being George Cooper and Sons (Nuneaton), Ltd. A deep pump chamber had to be constructed so that the 12in. pumps could be definitely charged with incoming sewage and automatically started with certainty by means of specially designed float switches.

The incoming electricity supply is derived from the Leicestershire and Warwickshire Power Company, through the three-phase, 6600-volt Corporation mains. As the river Anker runs between the electricity works and the pumping station, a special cable was laid in the bed of the river for this supply, in order to avoid the breaking up of the roads and footpaths in the centre of the town. This cable is controlled by a G.E.C. truck cubicle switchboard in the sub-station, which also controls the high-tension side of two 200 kVA transformers, with a ratio of 6600/440 volts. The 440-volt unit type ironclad switchboard which controls the circuits to the various pump motors is built up with the well-known Salford ironclad switches with bus-bar chamber and the necessary measuring instruments.

The motors are of the "Witton" pipe ventilated type, which are built to conform in every respect with British Standard Specification 168/1926. A particular feature of the machines is that all windings are impregnated both before and after assembly, thus rendering them particularly suitable for withstanding the somewhat damp conditions which are bound to exist in a pumping station. All these motors are controlled by G.E.C. automatic contactor control panels. The control panels for the two 120 H.P. motors and the 45 H.P. motor are operated by push-buttons and for the two 45 H.P. motors by an additional float switch. The construction and equipment of these panels vary only in detail, according to the duties to be performed. The cases of all the units are of sheet steel, and are provided with hinged doors for isolating switch and contactor compartments. Thus the apparatus is easily accessible for adjustment. An interlock is fitted, however, so that the door of the isolating switch compartment must be opened before access can be gained to the contactors. It should be noted that all operating coils are specially impregnated for use in a damp atmosphere. This method of control, using automatic remote-operated contactor equipment, is extremely convenient, and the gear has proved, we understand, to be thoroughly reliable in service.

SIXTY YEARS AGO.

The Channel Tunnel scheme, as our readers are doubtlessly aware, is no new idea. Sixty years ago schemes for connecting England and France by railway were being advanced at frequent intervals and discussed with much interest. From a leading article in our issue of November 6th, 1868, we learn that the schemes so far submitted could be divided into three classes. The first in order of seniority was the tunnelling proposal. The second covered the construction of a bridge. The third comprised the formation of an embankment with lock gates and a swing bridge at each end. We considered the tunnel scheme the best. Borings had proved that most of the ground to be traversed was quite practicable, and a small "island" halfway across would permit the establishment of an intermediate shaft so that the tunnel could be driven from four faces at once. The distance to be bored was 18 miles, and could, it was estimated, be covered in six or eight years. We anticipated that difficulties might be encountered from the existence of faults, the ingress of water from land springs, and in the matter of maintaining satisfactory ventilation during the construction of the tunnel. The construction of a bridge across the Channel would, we deemed, be comparatively easy provided the great difficulty almost certainly to be encountered in the erection of the piers could be satisfactorily overcome. Experience in the construction of piers in deep water was, we said, very limited, and what there was of it was not very encouraging. Even in the Thames great trouble had been met in getting in foundations in caissons and in keeping cylinders truly perpendicular. Given the piers the rest would be easy, and once the bridge was constructed not much trouble, we thought, would be experienced from the wind or sea. The embankment scheme we described as impracticable. It would, we held, be impossible by any known means to tip earth and stones as fast as the sea would wash them away. By the labour of years and the expenditure of a sum equal to the National Debt the thing might be done, but not otherwise. We advanced a fourth proposal. We suggested that floats about 1000ft. long and 120ft. wide, double-ended and each fitted with four screws and four 6000 I.H.P. engines, could be built to carry complete trains across the Channel at a speed of 25 miles an hour. Three such floats together with the necessary harbour works at each side could, we estimated, be provided for about £3,500,000. We thought such a scheme would pay, but without a guaranteed subsidy from the Government of France or England, it was not probable that money would ever be raised to test the question practically. Sixty years have passed and the Channel Tunnel still remains in embryo. The train ferries which we suggested came into existence during the war, and continue in operation on the Harwich-Zeebrugge route.

LARGE ELECTRIC EXCAVATORS.

For stripping overburden 60ft. deep to uncover coal for open mining, and to deposit this material in the cutting from which coal has been removed, some exceptionally large excavators, having buckets of 15 cu. yd. capacity, have been built in America. A heavy plate girder underframe mounted on three double-tread caterpillars, carries a revolving frame on which the machinery is mounted, and at the front end of which is pivoted a 95ft. steel boom, with luffing tackle. This boom carries a 60ft. handle, at the end of which is the bucket, so that the bucket can be extended to a distance of 108ft. from the centre of the revolving frame. In making a cut 54ft. deep in shale and rock shattered by blasting, the bucket makes its loading stroke in 15 to 18 seconds, the machine swings through 90 deg. to 120 deg. to the discharging position, and then swings back to another stroke, the complete cycle of operations taking 45 to 55 seconds. In working order the machine weighs about 850 tons. For hoisting the bucket in loading there are two 250 H.P. motors, while one 100 H.P. motor thrusts the bucket against the breast; two 100 H.P. motors swing the revolving element. A flexible armoured cable delivers 4000-volt, three-phase, 60-cycle current to the synchronous motor of a generator set, which supplies 250-volt current to the operating motors. With one operator and an oiler on each shift, the machine is operated twenty-four hours a day, and can handle 300,000 cubic yards per month.

Negotiations are reported to be proceeding between the leading makers of high-pressure cables with a view to the establishment of a syndicate. All countries in Europe are said to be taking an interest in the scheme, but for the present manufacturers in the United States are not participating in the discussions. It is declared that the negotiations are taking a promising course, although as a result of the large number of undertakings, it will not be easy to overcome the difficulties of reaching an understanding, as the industry in most countries, exclusive of Germany and England, is not in the hands of an organisation. It is said that the very keen competition in cables in international markets is giving the movement a strong impetus.

Institution of Electrical Engineers.*

PRESIDENTIAL ADDRESS.

The Electrical Industry.

I THINK it is now generally agreed that the Institution of Electrical Engineers cannot confine itself to the rigidly technical aspects of electrical engineering, to the exclusion of economic and industrial considerations. It is no use designing the best circuit breaker in the world if it is so expensive that no one will buy it. Whilst the orthodox definition of an engineer is one who "directs the great sources of power in Nature for the use and convenience of man," has not the engineer also been defined as one who does for sixpence what any fool can do for half-a-crown? He is met at every turn by questions of cost—cost of fuel, cost of labour, cost of transport, and scores of other questions of a purely economic nature. In fact, his success as an engineer more often than not depends upon how far he has been able to reconcile two apparently irreconcilable aspects of his problem, the technical with the economic.

The day's work of a given individual may provide him with a high standard of living if he possesses exceptional energy, exceptional ability or exceptional luck, but a high standard of living for the whole country, namely, the possession by everybody of a large number of the good things of this life, obviously entails their production in sufficient quantity. It is quite certain that the goods cannot be distributed until they have been produced, and the more each man produces, the more there will be to divide up between him and his fellows. In other words, for a country to have a high standard of living it must have a high rate of production per individual; that is, a high "productivity," as the Americans call it.

In order to verify the truth of this conclusion I have plotted in Fig. 1, for the year 1925, the average output of manufactured goods per individual operative[1] in a number of countries, against the average "real wage"[2] ruling there—that is to say, the average

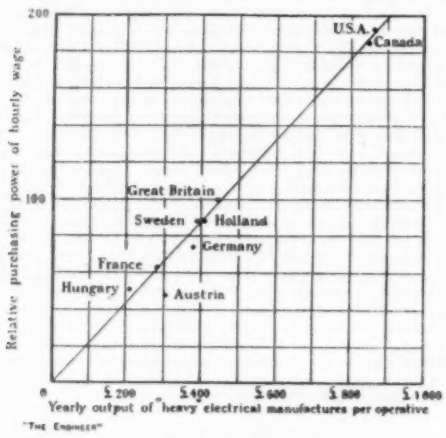

FIG. 1—COMPARISON OF REAL WAGES AND PRODUCTIVITY

hourly wage measured in terms of its food-purchasing power in that country. Whilst I looked for approximate proportionality, I must say that I did not anticipate such a remarkable corroboration of my contention that high productivity invariably results in a high standard of living.

Productivity.

Comparing the relative productivity in British industries in the years 1907 and 1924,[3] it may be said that whereas during the intervening seventeen years the number of operatives in the electrical industry had increased by some 30 per cent., the total output—as measured in kind and not in money—only increased by some 25 per cent., so that production per head had decreased by about 4 per cent. In the staple manufacturing industries as a whole it would appear that the output per operative had gone up by about 3 per cent. in these seventeen years.

It is thus safe to say that the annual output per head in this country has remained almost stationary during the last twenty years, so that it is hardly surprising that the standard of living still leaves so much to be desired.

If it is agreed that a high production per operative is desirable, what can be done to increase it? One of the most effective ways, of course, is to put at the disposal of each man as much mechanical power as he can usefully employ. There is plenty of room for improvement in this respect, and there can be no two opinions but that electricity affords the most economical and flexible means of applying such power.

Needless to say, another of the most potent aids to better and cheaper production is research. Sir William Bragg pointed out in his recent presidential address to the British Association that the most prosperous industries at the present time were those based upon recent research, and amongst them he included the electrical industry.

It is now generally agreed that much duplication and wasted energy can be obviated, not only in design and research, but also on the commercial side, by rational co-ordination, whereby the resources and experience of a number of manufacturers are pooled and production restricted to such articles as each can produce the most efficiently.

Of the various forms which "rationalisation" may take, the most advantageous is, I am convinced, not the formation of gigantic and often unwieldy combines, but the loose coupling, so to speak, of a number of specialist manufacturers to one another and to a co-ordinating central organisation. Such an arrangement affords all the advantages of co-ordinated control whilst still giving free play to that elasticity and individual initiative which are so characteristic of the specialist firm, but so difficult of attainment in the "department" of a big concern.

I have left to the last what is probably the most important factor of all, and that is the aggregate output. The larger the national output, the larger is the amount which the manufacturers of the country can expend upon research and upon improved methods of manufacture. Comparing the electrical manufactures of the three chief competing countries, the national consumption is relatively much as follows:—Great Britain, 1·0; Germany, 1·6; United States, 5·0. Thus, in this important respect, Great Britain is at a great disadvantage as compared with her two chief competitors.

Overseas Markets.

In order to increase his output the manufacturer naturally seeks outlets abroad. In this the electrical manufacturer has been particularly successful, having augmented the home demand by 25 per cent. or more through overseas sales. At the present time Great Britain, Germany and the United States each furnish about a quarter of the world's electrical exports. It is, however, much more difficult than formerly to find overseas markets, owing to the fact that so many of the countries which used to import now manufacture the goods for themselves and, in some cases, even export the surplus. This difficulty will undoubtedly increase as time goes on, so that it would seem to be to the advantage of this country to reduce to a minimum its dependence upon exports.

As things are, however, our manufacturers must export, not only in order to maintain the volume of output necessary for economical production, but also in order to "keep their hands in," so to speak, by the manufacture of material for which the home demand is at present small or even non-existent. The 132-kV overhead lines, transformers and switchgear now being manufactured in this country for the Central Electricity Board may be cited as an example.

In order to export, it is obviously necessary to sell at "overseas" competitive prices. Many people do not see why there should be any difficulty in this, and argue that there must be something radically wrong with the British manufacturer if he cannot produce as cheaply as his continental rival, and that until he does so he deserves neither sympathy nor support. Such reasoning might be sound if the manufacturing conditions in all countries were the same, but this is very far from being the case. Whether we take wages, taxation, working hours or any of the other ingredients which go to make up the cost of manufacture, we shall find that the conditions ruling in this country, however desirable they may be from other points of view, are unfavourable to cheap production.

It was seen in Fig. 1 that the real wages of a country—that is to say, wages as measured by the commodities which they will purchase—were approximately proportional to the output per operative. From this it might be argued that the competitive power of all countries should be approximately the same—at any rate as far as labour costs are concerned. It must be remembered, however, that the figures for real wages represent the value of an average hour's wage measured in kind, but that this may be very different from its value converted into sterling, which latter is necessarily the criterion for us as regards competition in the world's markets. Again, the length of the working week on the Continent is, in general, greater than ours, the conditions of payment for overtime are less stringent, the proportion of skilled operatives is smaller and so forth.

Taking all these considerations into account, the comparative position of Great Britain and Germany as regards production costs in heavy electrical engineering is shown in Fig. 2.[4] The cost of manufacture in Great Britain is taken as £100, and the assumption is made that factory and commercial expenses are the same for each country.

It will be observed that taxation, including both imperial and local, accounts for about £5 in this country, as compared with about £2 in Germany. But this is by no means the whole story. Taxation is cumulative in its effect and enters, at every stage, into every item of manufacture—labour, materials and overhead charges—in fact, it has been calculated that taxation in this country accounts in the aggregate for more than 20 per cent. of the total cost of production.

I have already alluded to the means which are available for increasing output and minimising production costs, and I think it may be said that the British manufacturer has gone as far in the direction of research, standardisation, co-operation, rationalisation, &c., as his limited home market will admit, and has but little to learn in this respect from other countries. But when all has been done there often remains an awkward gap between his manufacturing costs and the price at which he must sell overseas—a gap which is only partially bridged by the superior, lasting and other good qualities of his manufactures. On the other hand, unless he is in a position to obtain export orders, his output will suffer and his manufacturing costs will be still further increased. It is a vicious circle. There is only one way out of this *impasse*, and that is to sell at a lower price abroad than at home, thus maintaining an average price corresponding to the manufacturing cost. It might be thought that this would mean a higher price to the home consumer, but the opposite is the case.

Unemployment and its Cause.

We have become so accustomed to see, month by month, that the number of unemployed has gone up or gone down by a few thousands that there is a real danger of our looking upon a million or so as a normal condition. Alternate periods of good and bad trade have been with us for a hundred years or more, but if we contrast the unemployment figures of the last five or six years with comparable pre-war figures there would appear to be a permanent "surplus" of at least 800,000 persons.

Professor Pigou, the eminent economist, has propounded the interesting theory[5] that the present abnormal unemployment is due to the artificial forcing up of the wage of the manual worker, and particularly of the unskilled manual worker, to a level which is too high, having regard to the existing openings for

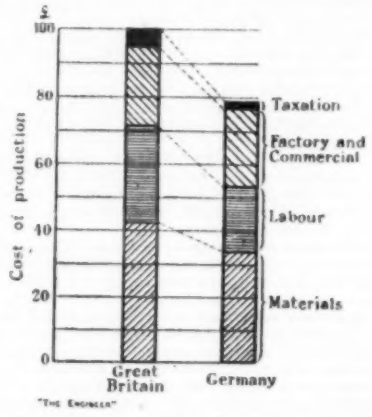

FIG. 2—RELATIVE MANUFACTURING COSTS

employment. It is clear that if, in any given industry, wages are forced above the "economic" level, unemployment will result in that industry, but this is, I think, the first time that nation-wide unemployment has been ascribed to the demand by a large section of the population for a remuneration which is excessive, as compared with that of other sections. The remedy, short of reducing wages, is to increase productivity to such an extent that the return per unit wage is restored to the economic level, an effective way of doing this being to increase the total output so that more intensive methods of production can be employed.

But others will maintain that over-production is itself at the root of unemployment and that, although possibly from the point of view of the community increased production due to mechanisation and improved methods of manufacture may be all to the good, yet as regards the individual it must lead to unemployment. Experience in other countries fails to bear out this contention. In the United States, for example, the output per operative is said to have increased by 40 per cent. since 1914, and yet the number of operatives is said to have increased concurrently by 20 per cent.

To me it would appear that under-production can be quite as much to blame as over-production. In fact, if Professor Pigou's explanation is correct, under-production not necessarily per individual but per hourly wage paid is wholly responsible for it. I do not regard unemployment as a symptom that commodities as a whole are being over-produced or under-produced, so much as that they are being produced in the wrong relative quantities from the point of view of consumption. If free play were given to the effects of supply and demand, equilibrium would be restored, automatically, within a reasonable time. But under modern conditions such free play is impossible, so that some other remedy must be applied.

The Search for a Remedy.

If this diagnosis is correct, the remedy is clearly either to reduce the output of some commodities or

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* Abstract of presidential address delivered by Lieut.-Col. K. Edgcumbe on October 25th.

[1] The production per individual, which refers to heavy electrical goods, but is probably typical of most other forms of manufacture, is taken from various sources, as given on page 20 of the monograph addressed to the Economic Conference of the League of Nations by the B.E.A.M.A. in 1927.

[2] Taken from "Survey of Industrial Relations" by the Government Committee on Industry and Trade, page 102.

[3] "Further Factors in Industrial and Commercial Efficiency" (Government Committee on Industry and Trade), page 5.

[4] From data supplied by the B.E.A.M.A.

[5] *Economic Journal*, September, 1927, page 355.

to increase the output of others—that is, to level down or to level up. Although each method might be equally effective as regards employment, it must be remembered that levelling down production means "short time," increased prices, and, in fact, a lower standard of living all round. Levelling up, on the other hand, means raising the standard of living.

To remedy unemployment by levelling up production two things are necessary, a transference of operatives from the less active to the more active branches of industry, and concurrently a general increase in the country's trade. Is it possible to secure this extra trade and so give the required initial stimulus? The answer must depend upon what additional output of commodities would be involved in the re-absorption of the present surplus of 800,000 operatives.

If we assume an average wage of 45s. per week, the earnings of 800,000 would be about 90 million pounds per annum. It may be said that at least 65 per cent. of the cost of any article goes either directly or indirectly in wages,[6] using the term in its broadest sense. Taking this figure, a wage bill of 90 million pounds would correspond to a selling price of 140 million pounds. If, therefore, the country's output of manufactured articles were increased by 140 million pounds per annum, some 800,000 operatives could be re-absorbed and the unemployment problem would be practically solved.

But is such an increase within the range of possibility? As far as concerns the capacity of manufacturers to turn out the goods no difficulty would be experienced, since the majority of the factories of the country are at present working far below their efficient capacity.

An Initial Stimulus Essential.

The problem is to find a market. As regards overseas trade, in face of the difficulties I have already enumerated there does not seem to be any prospect of material expansion, and we are therefore left with the home trade. It is clear that the consumption of the country cannot be suddenly expanded, but it will be found that of the manufactured goods consumed in the United Kingdom about 320 million pounds' worth are made abroad. Of these, it seems reasonable to suppose that at least half, or 160 million pounds' worth, could be equally well made here. But we are only looking for a market for 140 million pounds, so that this would seem to provide the required solvent for the country's surplus labour.

I need not enlarge upon the moral advantages to the community of removing the degrading influence of unemployment, nor of the material gain which would follow when, instead of the employed having to carry the unemployed, these latter would once more take their share in production, and so help to raise the standard of living of the country.

Against these obvious advantages must be weighed the disadvantage, if it is one, that whereas we may now flatter ourselves that we are saving a shilling or two by purchasing a possibly very attractive looking foreign-made article, we should then have to restrict ourselves to the more durable British product. I calculate that this extra expenditure, spread over all our purchases,[7] might amount to 2d. in the £.

The Electrical "Barometer."

Endeavours have been made of late to find a "barometer of industrial activity" in this or that industry, but usually with little success. In our own, however, we have a most excellent barometer, almost ready to hand. The annual output of electrical energy represents a kind of "prosperity index," not only for the supply industry and to a lesser degree for the manufacturing industry, but for every branch of the profession.

Just as with the true barometer the endeavour is to predict the weather of the future by extrapolation from data relating to the past, so with the barometer of electrical output our chief interest is to use it as a means of looking into the future of our industry. The Committee under the chairmanship of Lord Weir made, in 1925, one of the first prophetic ventures in this direction when they boldly based their estimates and recommendations upon a consumption of 500 units per annum per head of population, the consumption at the time being 200 units only. Since that date the Electricity Commission, the Central Electricity Board and others have published estimates of the future output of public supply undertakings in particular districts, but it is difficult to determine from these the probable total output of the country, which is what interests us most.

I have thought it worth while, therefore, to piece together such data as seemed relevant, with a view to forecasting the course of our prosperity index during the next ten or twelve years. In this I have had the valuable assistance of Mr. Hugh Quigley, of the Statistical Department of the British Electrical Manufacturers' Association, who has devoted so much study to the statistics of the electrical industry.

The curves shown in Fig. 3 are the result of these efforts. The lower curve shows the energy supplied by the statutory undertakings up to date, and the dotted straight line indicates what would be their future output if the annual increase continued as during the last few years. This rate of increase may be looked upon as a minimum, based as it is upon five years during which the industrial conditions of the country have been worse than any known to the present generation. But taking the facts as they stand, the output at the present time is increasing at the rate of about 10 per cent. per annum in the case of the statutory authorities, and probably at a slightly lower rate for the country as a whole.

Figures of 15 or even 20 per cent. have been quoted as representing the annual rate of increase, but these are, I think, somewhat misleading, being based upon the output for 1927 as compared with 1926, a year of industrial trouble in which the output was only 3 per cent. greater than in 1925. I do not actually see any justification for assuming a given percentage increase. The correct procedure is, I think, to consider the various factors and from them to assess the future output as closely as may be.

The lower curve of Fig. 3 does not take into account the output of any private or non-statutory plants, but an estimate can be made of their output for 1924 from the census of production. Adding this figure, we obtain a known point on the upper or "total output" curve of 10,400 million units for that year. After

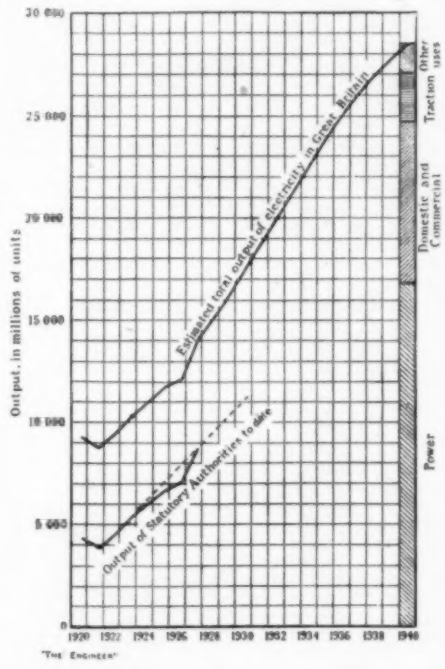


FIG. 3—ESTIMATED ELECTRICAL OUTPUT

this no exact figures are available, and from 1928 onwards we launch out into pure speculation.

Factors Affecting the Future Output.

It is not possible to discuss all the factors which have been taken into consideration in arriving at the prophetic curve; in fact, I doubt if in any case it would show worldly wisdom were I to do so. Have we not been told that the wise man states his conclusions but withholds his reasoning, since his conclusions may be right, but his reasoning is certain to be wrong.

However, a few of the more important factors may be mentioned. Apart from traction, power accounts for about 71 per cent. and lighting, together with other domestic uses, for only about 10 per cent. The annual statistics, however, show that the amount used for domestic purposes is increasing more rapidly than that used for power, so that the lighting load—domestic, commercial and industrial—together with the domestic power load, would seem to offer the greatest relative scope for expansion. It is, moreover, much less affected by periods of bad trade than is the power load.

The domestic field in this country is still largely untilled. According to the Electrical Development Association, the number of electrically equipped houses represents about 20 per cent. of the total number, compared with a reputed 60 per cent. in the United States and 45 per cent. in Germany. Although the number is at present increasing by about 25 per cent. each year, there is still plenty of room for expansion. If every year the number of houses built and the number of additional houses connected to the mains continued as during the last year or two, the number of electrically equipped houses would, in ten years' time, represent from 55 to 60 per cent. of the total. But it is not only or even chiefly to the number of houses connected to the mains that we should look; it is in the more extended use of electricity by each household that there is so much room for expansion.

In spite of the fact that the degree of mechanisation in this country is in general less than in either Germany or the United States[8] and must presumably remain so, owing to the much smaller home market open to our manufacturers, it still seems reasonable to anticipate an expansion, during the next ten or twelve years, of well over 100 per cent. in the electrical power consumed by industry.

It is difficult to assess the future agricultural demand, but it is noteworthy that in Germany the total mechanical power used per acre is more than double ours, and that nearly 80 per cent. of this is electric. Hence there is clearly room for considerable expansion in this direction.

Much the same may be said of main line electrification. In this country, in common with France and Germany, less than 2 per cent. of the whole mileage is at present electrified, so that there is an enormous potential demand for electric power—a demand which, in view of the manifest technical advantages of electricity, must sooner or later be met. The obstacles are financial and not electrical or even economic.

At present nearly half of the country's output of electricity is generated by private plants, but the proportion will undoubtedly decrease very considerably as a public supply becomes available on more and more advantageous terms and as existing plant becomes obsolete. Thus the proportionate difference between the curves of total output and of the output of authorised undertakings will become progressively less.

Conclusions.

All things considered, I estimate that in twelve years' time the country should have a total output of 28,000 or 29,000 million units, or nearly 600 units per head of the population.

In arriving at these conclusions I have assumed, first, that effective steps are taken to popularise and extend the use of electricity; secondly, that the national scheme fulfils our expectations—I will not say the expectations of the man in the street—and thirdly, that no awkward kinks are imposed upon the curve such as were caused by the industrial troubles of 1926. Let us remember that the industry has a commodity to sell and that the livelihood of the vast majority of the 13,000 members of this Institution depends upon its being sold. Unfortunately, nothing sells itself, even when it has a virtual monopoly, which electricity certainly has not.

It has always been a matter of surprise to those engaged in other branches of the industry how little the supply side has had to trouble itself about seeking out a market for its goods. In other branches, highly organised sales departments have proved essential, whereas in the Elysian fields of the supply business customers come clamouring for a supply—sometimes, I fear, only to be sent empty away. Under the new dispensation many of the undertakings will be relieved of at least some of their anxieties as regards production, so that they will be in a better position to deal with the many-sided problems of distribution—not forgetting, I hope, intensified propaganda.

The Electrical Development Association is doing yeoman service in this direction, and so is the Electrical Association for Women, but these and similar organisations must be backed up, and in this we look, not unreasonably, I think, to the supply branch to give us a lead.

Finally, we may, I think, regard the future with confidence. We have much to be thankful for. In these days of pessimistic utterances and depressing statistics it is something to be connected with an industry which bids fair to double or even to treble itself within the next twelve or fifteen years. But that is the purely material aspect. From a more altruistic point of view, not only do we control the most potent force for the advancement of civilisation that the world has ever known, but I firmly believe that electricity has come to the rescue of mankind just when the stress and strain of that very civilisation were threatening to overwhelm him.

B.E.S.A. SPECIFICATIONS.

CONCRETE KERBS, CHANNELS AND QUADRANTS.

The British Engineering Standards Association has recently issued a specification for concrete kerbs, channels and quadrants in Portland cement. The specification contains requirements as to the aggregate, the preparation of the concrete, and the moulding, and includes tests for transverse strength and absorption, and a minimum weight per cubic foot. Provision is made for the use of rapid-hardening cement. Seven sections of kerbs, with quadrants to match, and one section of channel, have been standardised. Copies of the specification—No. 340, 1928—may be obtained from the publication department of the British Engineering Standards Association, 28, Victoria-street, London, S.W. 1, price 2s. 2d. post free.

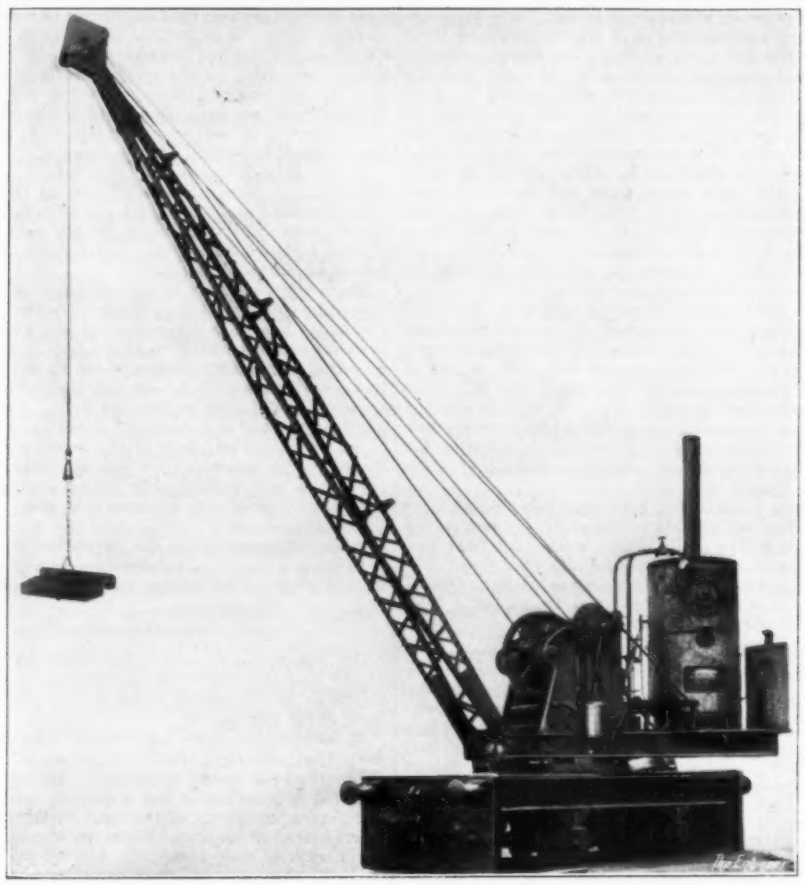
[6] Professor Bowley calculates ("The Division of the Products of Industry," page 32 *et seq.*) that, before the war, 56 per cent. of the value of the "net output" of industry in this country was represented by wages and small salaries, the remaining 44 per cent. being represented by larger salaries, rates, depreciation, rent, royalties, interest on loans, and profit. Of these, it is clear that a large part will be expended by the recipients directly or indirectly on labour. Allowing for this, and making some further allowance for imported materials such as copper, cotton, rubber, &c. (the labour expended upon home-produced materials is already included in Professor Bowley's estimate), 65 per cent. may be considered to be a safe working figure for finishing industries such as we are considering.

[7] Only some 8 per cent. of purchases would be affected, and assuming that the price of these was 10 per cent. higher for the British than for the foreign article (a figure which certainly errs on the high side if quality is taken into account), the possible extra expense involved would amount to 2d. in the £ spread over all purchases.

[8] The figures for horse-power per operative usually quoted for the United States must be accepted with some reserve, if a comparison is to be made with the corresponding figures for Great Britain, since the interpretation of the word "operative" or "wage-earner" appears to differ in the two countries.

3½ TON SELF-PROPELLING STEAM JIB CRANE

THE BEDFORD ENGINEERING COMPANY, BEDFORD, ENGINEERS



A New Steam Jib Crane.

A STEAM jib crane of a new form, which possesses some particularly interesting features, has recently been constructed by the Bedford Engineering Company, of Bedford. It is illustrated in the accompanying engraving. The machine, the capacity of which is 3½ tons at 30ft. radius, is intended largely for use in connection with a grab, but it will also be employed for handling ordinary loads.

The hoisting gear is of the single-purchase type, and it has a mild steel pinion, with machined teeth, which slides upon double feathers on the crank shaft, and can be put out of gear when lowering with a free barrel. The hoisting wheel, which is of cast steel with its teeth machine cut from the solid, is bolted to a flange on the hoisting barrel, an arrangement which permits of keys being dispensed with. It carries a large diameter brake ring, which is encircled by a brake strap lined with Ferodo. The hoisting barrel is of cast iron and the grooves for the accommodation of the rope are machine cut.

The slewing motion is operated by reversing friction cone clutches—cast iron to cast iron—and is furnished with an arrangement cut for transferring the thrust direct to the side cheeks of the crab. The cones are operated by cast steel bevel gearing the teeth of which are machine cut from the solid. There is also a horizontal spur gear which is of cast steel. The roller path, which is of cast steel, is of massive design and has internal teeth also machined from the solid. The top face is turned to form a path for the superstructure rollers, while the lower face is machined to register with a corresponding seat upon the crane bed. The required reaction between the main slewing pinion and the main slewing ring for turning the revolving portion of the crane is obtained entirely by friction between the surface of the ring and the crane bed.

The gearing for actuating the travelling motion consists of a number of bevel and spur wheels, the pinions all being of mild steel with teeth machine cut from the solid. The axles of the crane are spring-borne, and the axle-boxes slide in mild steel horn plates. They are driven by spur gearing arranged to allow of the necessary vertical movement. All the wheels of the bevel and spur gearing are of cast steel, and all the teeth are machine cut from the solid.

The carriage consists of a cast iron bed which carries the post and roller path mounted in a mild steel framing. It is provided with buffers, draw hook, and chain, and the buffer beams are taken down to within a few inches of the rails.

The derricking gear is operated by means of bevel steel bevel and worm gearing, all the wheels having teeth machine cut from the solid. The derricking barrel, which is of cast iron, has right and left-hand machine-cut grooves for the accommodation of the rope.

Two complete engines are coupled to the crank shaft at right angles to one another. They have vertical cylinders and the crank discs are balanced. The boiler is of the cross-tube type, and is furnished with asbestos-packed fittings. Both it and the cylinders are lagged and finished with blue steel sheeting. The steam piping throughout is lagged with silicate tape.

The levers for effecting the movements of the crane are all arranged within easy reach of the driver, while the slewing is operated by means of a hand wheel. Although it is not shown in our illustration, the mechanism is completely enclosed in a housing.

Tunnel Construction and Main Line Deviation on the Central Railway of Peru.*

By FRANK FREDERICK HIXSON, Assoc. M. Inst. C.E.

THIS railway, which is the highest standard-gauge railway in the world, begins at sea level at the Pacific port of Callao, about 12 deg. south of the equator. It passes through Lima (km. 14), 500ft. above sea level, and at km. 172 it reaches an altitude of 15,806ft. before descending the Atlantic side of the Andes to the mineral and agricultural districts that it serves. The entire return journey from the summit to Callao can be made in a gravity car. Running parallel to the coast, approximately between altitudes of 3000ft. and 8000ft., is a zone from latitude 6 deg. to 13 deg. south of the equator, in which engineering works are rendered very difficult on account of a mysterious disease, known as the verrugas, which attacks all classes of labour working for any length of time in the district.

Location.—When the railway was constructed in 1870 in the Purhuay district (elevation about 4000ft.) it crossed the Rimac River twice near km. 66 below and above the confluence of the Purhuay Valley. No provision had been made for passing the river under or over the railway, and there is little doubt that in the days of construction the valley was dry. No interruptions to traffic were recorded until 1890, when an avalanche cut communications for some months. Serious interruptions followed in 1897, 1915, and 1919. On the last occasion traffic was resumed in four days over a temporary 8 per cent. gradient, but a further fourteen weeks elapsed before traffic was resumed over the old line. In 1920 a reinforced concrete shoot was built to pass avalanches over the track, and this successfully carried avalanches in 1923 and 1924 In 1925 unprecedented rains fell in all parts of Peru. On March 19th the track in the Purhuay Valley immediately adjoining the shoot was covered by an avalanche to a height of 40ft., the main line from km. 39 to 67 being partly destroyed. A temporary location was therefore laid out with a 5 per cent. gradient, and by a temporary 66ft. span bridge, traffic was restored on the May 13th. The river near this bridge site has a 6 per cent. gradient, so that during flood its velocity is very high.

The only available bridge was only a few feet longer than the width of the river. As the bed consisted of sand, gravel, and large boulders, pile driving was impossible and excavation was difficult. The piers were therefore founded on a mattress of 1 : 2 : 4 concrete and old rails. Excavation was begun 24ft. from the water's edge and carried down 2 m., which was the greatest depth permitted by infiltration. The pit was extended towards the river, when it was 1 m. deep. To minimise infiltration old rails were driven as piles in conjunction with pointed 12in. by 3in. timbers to form a cofferdam, in front of and behind which freshly mixed concrete in sacks was dumped to prevent scour. A pump kept the water inside the dam as low as possible. Granite abutments were then built near the ends of these cantilever mattresses which supported heavy traffic, hauled by 124-ton engines, until the beginning of the following rainy season.

In the meantime a 40 m. through span had been ordered, and to support this massive foundations were constructed 4 m. below river level. The new bridge was put into service in December, 1925. By this time the floods had begun, and the 66ft. span was removed only just before the river destroyed its foundations. The new bridge abutments were protected by defence works until a diversion tunnel was finished.

Tunnel.—The survey and construction of the tunnel were very difficult on account of the broken nature of the country, which necessitates the provision of a curve at each end. Further, as it was not possible to see both ends from any one point, the location had to be calculated and fixed by triangulation, the longest possible base line being about 112 m. The distances along the centre line of the tunnel checked to the nearest centimetre, and the final levelling over a distance of more than 500 m. met with an error of 1 cm.

As the unhealthiness of the district made it necessary to employ a minimum of skilled labour, and as the sinking of a shaft was impracticable, it was decided to drive an adit and to work the tunnel simultaneously on four faces.

The tunnel is located on a 3 per cent. gradient, with its south approach on a 4 per cent. gradient. The curve at the south end has a radius of 250 m. and that at the north end 200 m. The total length is just short of 500 m. It is 6 m. high above floor level. The arch has a radius of 2·40 m., the height from floor to springing is 3·60 m., and the tunnel is 4·20 m. wide at the base.

An 8ft. by 8ft. heading was first excavated from the crown. This heading was then enlarged for the whole length of the tunnel to the finished dimensions of the arch. Finally, working from the two ends, the bench of the tunnel was removed. Material excavated from the arch was removed by Decauville trucks through the adit and dumped into the river; the remainder was removed at the two ends. The arch widening was done by "drifters," and continued whilst the benches were being excavated. The rock from the benches was removed by scraping machines operated by double-drum air-driven hoists mounted on a wheeled carriage. The scraper dragged the spoil up an incline and dumped it into cars. These scraping machines were very successful and were able to load a 1 cubic yard car in two minutes. The cars were operated by means of compressed-air single-drum winches. The granite rock through which the tunnel was driven is extremely hard. In certain parts of the heading as much as 21 lb. of 75 per cent. dynamite was used to dislodge 1 cubic yard.

More than 5 tons of special Swedish 1¼in. hollow round steel was used for drills. In certain sections drills frequently had to be resharpened after working 12in. to 15in. Drilling was performed by compressed air drifters mounted on columns. In the heading sixteen to twenty holes up to 6ft. deep were charged with 50 lb. of dynamite; the break, however, often did not exceed 3ft. in depth. In other parts of the tunnel 40 lb. of dynamite in fourteen to sixteen holes failed to break more than a depth of 3ft. With a view of minimising the use of skilled labour one large steam driven single-stage air compressor with a displacement of 2000 cubic feet of free air per minute ran all necessary plant. This operated the tool sharpener, two hoists, two air winches, six to eight drifters, and other small units.

This work was started in December, 1925, and the line was handed over to traffic in August, 1926.

Ventilation.—No ventilation plant was used, and up to a length of 50 m. no inconveniences from gases were experienced; beyond this distance, however, it was necessary to blow in air after blasting. Under the worst conditions 300 cubic feet of air per minute was blown into each face for 2 hours in order to purify the air sufficiently to allow the men to work. If a similar tunnel were again driven it would be cheaper and more convenient to lay down a special plant for ventilation of heading longer than 300ft.

Dynamite.—The following table gives details of the dynamite used in the different stages of the work :—

Work.	Dynamite.	Excavation.	Lb. per cub. m.	Cost per cub. m.	Total cost.
	lb.	Cub. m.		Sols.*	Sols.
Adit	2,100	520	4·04	2·90	1,509
Heading	26,850	2,691	9·94	7·17	19,300
Arch widening	3,325	1,437	2·31	1·66	2,390
Full section ..	24,150	8,022	3·01	2·16	17,359

* The sol has a present value of about 18·5d.

* Abstract of a paper to be brought up for discussion at the Institution of Civil Engineers.

The Institute of Fuel.

NOVEMBER CONFERENCE.

THE annual two days' conference of the Institute of Fuel will be held at the Institution of Electrical Engineers, Savoy-place, Victoria Embankment, London, W.C. 2, on Wednesday and Thursday, November 21st and 22nd, 1928, commencing each day at 10 a.m. On Wednesday morning, the 21st, the President, the Rt. Hon. Lord Melchett, P.C., LL.D., will deliver his address, which will be followed by a paper on "Fuel Conservation in Locomotive Practice," by Sir Henry Fowler, K.B.E., LL.D., Chief Mechanical Engineer of the London, Midland and Scottish Railway. After the discussion on this paper the meeting will adjourn for lunch.

In the afternoon three papers will be presented in abstract, dealing with the "Economics of Coal Production and Distribution." Mr. George Raw, of New Washington, will discuss "Production," Professor Henry Louis, D.Sc., M. Inst. C.E., of Newcastle-on-Tyne, "Preparation," and Captain Roland Addy, managing director of the Carlton Main Colliery Company, Ltd., "Marketing." These papers will all be discussed together.

The annual dinner will be held in the evening.

On Thursday, the 22nd, the whole day will be devoted to a symposium on "Fuel Control in Industry," to which

the following authors will contribute papers, presented at the meeting in abstract form :—

MORNING.

Dr. Ing. F. Münzinger, director, Allegemeine Elektricitäts Gesellschaft, Berlin : "Electric Power Stations."

Dr. E. S. Grumell, Fuel Department, Brunner, Mond and Co., Ltd.: "The Chemical Industry."

Messrs. A. J. Dale and A. T. Green : "Ceramic Industry."

Dr. Geoffrey Martin, consulting chemical engineer : "The Cement Industry."

Mr. T. A. Peebles, Vice-President of the Hagen Corporation, Pittsburgh : "American Practice and Experience."

Mr. James R. Edwards, fuel and steam engineer, Lever Bros., Ltd., Port Sunlight : "Practical Results of Fuel Control."

AFTERNOON.

Mr. Martin J. Conway, of the Lukens Steel Company, Coatesville, Pa.: "Liquid Fuel in Open-hearth Practice."

Mr. J. L. Bentley, of Robert Heath and Low Moor, Ltd.: "Fuel Control in Open-hearth Practice."

Mr. H. C. Armstrong, of John Brown and Co., Ltd.: "Fuel Control in Reheating Furnaces."

Mr. J. B. Fortune, of the New Cransley Iron and Steel Company, Ltd.: "Fuel Control in Blast-furnace Stoves."

The Council of the Institute has invited the members of the following Institutes to be present at the various sessions indicated :—

Wednesday morning : The Institute of Transport.

Wednesday afternoon : The Institution of Mining Engineers, the National Association of Colliery Managers, the Mining Institute of Scotland, and the South Wales Institute of Mining Engineers.

Thursday afternoon : The Iron and Steel Institute, the National Federation of Iron and Steel Manufacturers, the Cleveland Institute of Engineers, and the West of Scotland Iron and Steel Institute.

Catalogues.

HOPKINSON, Ltd., Huddersfield.—List No. 2180 of "Mac" valves.

J. BROWN AND CO., Ltd., Sheffield.—Brochure, "Hollow Forgings for High Pressures."

DEE SUPERHEATERS, Ltd., Netherton, Dudley.—Folder on superheaters and superheating.

HEAD, WRIGHTSON AND CO., Ltd., Thornaby-on-Tees.—Booklet 1916 on blast-furnace plant.

IRA STEVENS, Ltd., Ashton-under-Lyne.—"The Conveyor Belt : Installations and Examples."

BOSTOCK AND BRAMLEY, Ltd., Vauxhall Works, Reddish.—Booklet "Enveloping Worm Gear."

NUNAN AND STOVE, Ltd., 118, Broomielaw, Glasgow.—Particulars of a new type of water gauge.

RIPAULTS, Ltd., King's-road, London, N.W. 1.—"Everybody's Battery Book."

D. H. BONNELLA AND SON, Ltd., 46, Osnaburgh-street, N.W. 1.—Catalogue Section L of electric lighting accessories.

WALKER, CROSWELLER AND CO., 54, Queen Elizabeth-street, S.E. 1.—Leaflet on the "Arkon" universal planimeter.

RICHARD GARRETT AND SONS, Ltd., Aldwych House, Aldwych, W.C. 2.—Book on the Garrett six-wheeler steam wagon.

J. H. STEWARD, Ltd., 406, Strand, W.C. 2.—Catalogue S.M. section of surveying, drawing, and nautical instruments.

STANDARD TELEPHONES AND CABLES, Ltd., 63, Aldwych, London, W.C. 2.—A booklet on the cathode ray oscillograph.

DOWDING'S MACHINE TOOL COMPANY, Ltd., 38, Albert Embankment, S.E. 11.—Particulars of Zeiss measuring machines.

ELECTRIC FURNACE COMPANY, Ltd., 17, Victoria-street, London, S.W. 1.—A folder on electric furnaces for all purposes.

HARDY PATENT PICK COMPANY, Ltd., Sheffield.—Particulars of patented "Hardy" petrol-driven compressors and air tools.

SIEMENS BROTHERS AND CO., Ltd., Woolwich, S.E. 18.—Catalogue 160, Section VII., dealing with tee and service boxes.

AVELING AND PORTER, Ltd., Rochester.—Catalogue No. A38, giving drawings and illustrations of the "Aveling" concrete mixer.

J. W. BROOKE AND CO., Ltd., Lowestoft.—A descriptive leaflet of the "Seacar" motor boat and the "Empire" 10 H.P. marine motor.

STERNOL, Ltd., Royal London House, Finsbury-square, E.C. 2.—"The Care of the Ruston and Hornsby Cold Starting Heavy Oil Engine."

W. B. DICK AND CO., Ltd., 26, Grosvenor-gardens, S.W. 1.—A booklet entitled "Scientific and Economic Diesel Engine Lubrication."

SULLIVAN MACHINERY COMPANY, Salisbury House, London Wall, E.C. 2.—Notes on the advantages of the Sullivan coal-cutting machine.

JAMES ARCHDALE AND CO., Ltd., Ledsam-street, Birmingham.—The fifteenth edition of the firm's catalogue of drilling and milling machines.

DAVID WILSON AND COMPANY, 40, Brazennose-street, Manchester.—Leaflets describing the "Fisher" continuous drainer or condensate trap.

THE HOFFMANN MANUFACTURING COMPANY, Ltd., Chelmsford, Essex.—A folder illustrating a selection of machines using Hoffmann bearings.

J. PARKINSON AND SON, Shipley, Yorks.—Book H.H.8 on "Parkson" plain and universal milling machines and "Sunderland" gear planers.

THE INSTITUTION OF CHEMICAL ENGINEERS.—The Institution of Chemical Engineers held the President's annual reception on November 7th in the New Princes Galleries. A very large and important company was present, and was received by Sir Alexander Gibb, G.B.E., C.B., the President, and Lady Gibb.

ROYAL ENGINEER VOLUNTEERS.—Lieut.-Colonel C. B. Clay informs us that the annual dinner of the London Army Troops Companies Group—Royal Engineers, will be held on Friday, November 23rd, 1928, at the Café Monico. Application for tickets from past members of the Corps and also its predecessors, the Engineering Institutions' Volunteer Corps ; the Architects' Corps ; the L.C.C. Corps, may be obtained from Mr. C. E. Campbell, 25, Newman-street, Oxford-street, W. 1, or from any of the past officers.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market in Repose.

THERE has been no marked change in industrial conditions in the Midlands and Staffordshire during the past week, and as a consequence iron and steel sales have been on the quiet side. In some of the trades of the district the outlook is regarded as bright, but in others considerable trepidation is felt as regards the future. Where order books are good manufacturers appear to have covered their requirements some little way forward, and unless an improvement in the trades now quiet develops, there seems little prospect of any considerable volume of business for iron and steel coming on to the market for some weeks to come. The strength which seemed to be developing in the basic industries a month ago has unfortunately not been consolidated. Makers have, in most cases, reduced their stocks, and some of them have obtained orders which will enable them to carry on quietly for some time at the present limited rate.

Scarcity of Steel Orders.

A scarcity of orders for plates and heavy steel generally is indicated by the rolling lists received from steelworks. The plate mills are equipped for heavy production, and the present restricted demand is nothing like sufficient to allow of a week's full work at any of the establishments. The shipbuilding yards are not calling for the quantities of material which it was anticipated some time ago they would require. The depressed state of the shipbuilding industry is reflected not only amongst plate makers, but in the cable and chain-making trades of South Staffordshire. Constructional engineers have experienced a falling off in business during the last few weeks, and their calls upon the steelworks are comparatively insignificant. It is sincerely hoped that the railway work which is known to be pending will be given out before long. It is undoubtedly badly needed by the steelworks. Prices continue at £7 17s. 6d. for angles and joists, and £8 12s. 6d. for plates, the official minimum confirmed recently by the Steel Association. In the half-products branch values have been slowly moving upwards since June under the new direction which continental stringency has given to the market. This week some sellers advanced quotations by half-a-crown per ton, but users did not appear willing to pay the increased price. Some native makers have of late taken more business in billets than for a long time past, but the position has not apparently been strengthened sufficiently to justify the general adoption of the £6 7s. 6d. level. Continental competition is maintained, and Belgian and French materials are this week quoted at rather lower rates. Billets are down to £5 17s. 6d. delivered, as compared with £6 5s. to £6 7s. 6d. for English steel ; and No. 3 iron can be had at £7 delivered, and steel bars £7 5s. Sales of continental materials are on the small side, but deliveries have improved.

Raw Iron.

Sales of pig iron this week have been confined to small parcels for current consumption. In many cases they have not exceeded 10 tons. With buying on this scale it is not surprising that thoughts have been turning to further restriction of output rather than to the rekindling of idle blast-furnaces. Rumours have been current this week that the closing down of a Nottinghamshire furnace is imminent, but no confirmation of this is at the moment obtainable. Though the market has gone quiet, many Midland blast-furnacemen have considerably improved their position of late, and stocks having been considerably reduced they are not so perturbed as they might otherwise have been. They still continue their efforts to secure business in markets further afield. Cleveland producers of pig iron have maintained their prices at a point which has enabled Northamptonshire and Derbyshire makers to extend the radius of their sales. Smelters are anxious to obtain the best possible price for the iron now being produced or taken from stock, and values are firm at £3 for Derbyshire No. 3 foundry iron, and £2 17s. to £2 18s. for Northamptonshire. Local foundries are in none too happy a position, and the forges are poorly employed. Their demands can be met without any difficulty, so that there is little prospect of additional furnaces being brought into operation in this area for supplying the market until matters mend. Industrialists generally, however, remain optimistic.

Staffordshire Bars.

Staffordshire makers of marked bars are keeping up a steady output, but additional orders are required to ensure regular running of plants. Few firms have any bulk of work on their books, but rely upon small scale business coming along week by week. The price is maintained at £12 per ton. For Crown iron the keen competition produces a wide divergence of prices, mills in this district asking upwards of £9 10s., whereas other districts are charging £9 2s. 6d. For nut and bolt qualities prices range between £8 12s. 6d. and £8 17s. 6d., with very small sales. The tube trade is consuming good quantities of strip, and this branch is perhaps the most satisfactorily placed of the industry. Wrought iron gas-tube strip sells at £10 15s. to £10 17s. 6d.

Sheets and Tin-plate.

Galvanised sheet prices are unchanged. Corrugated sheets of 24-gauge sell readily at £13 10s. to £13 15s. Most of the mills have work in hand for the rest of the year, although here and there gaps need to be filled in the order books. Thinner gauge sheets and black sheets are in fairly good request at recent rates. Last week's slight improvement in the tin-plate trade in this district has not been maintained, and business this week has been decidedly quiet. Merchants report having been advised that negotiations for exports to the United States and American territories, as well as to Italy, must be referred to headquarters before being completed. This is an outcome of the compact between Welsh and American interests to avoid competition in defined spheres.

Coventry Engineering.

The motor engineering industry in Coventry is, on the whole, in a fairly satisfactory condition and prospects, especially for makers of light cars, are considered good. Works are becoming increasingly busy, and in some cases extra shifts are being worked. The demand all round appears to be good, and manufacturers express themselves as well pleased with the results of the Show. Aeroplane and aeroplane engine construction is becoming an increasingly important factor in Coventry's industrial life. Engineers in this branch are receiving considerable orders, and are able to employ additional labour. A local firm, the aeroplane engines of which have been associated with recent accomplishments, has received a further order for three improved air liners, with spare engines in each instance, from Imperial Airways, Ltd. Electrical engineers are active on radio equipment and magnetos.

New Steel Furnace.

Alfred Hickman, Ltd., tube makers, of Spring Vale Works, Bilston, Staffordshire, are, I learn, about to build a new Siemens steel furnace. It is stated by an official of the firm that this does not necessarily indicate increased prosperity in the steel industry. He pointed out that the works belonged to a big combine, of which Messrs. Stewart and Lloyds are the principal firm, which absorbed their output, and it was mostly to meet the requirements of the combine that the new furnace was being built.

Leicestershire Colliery to Close Down.

It is with regret I have to record that the Ibstock Colliery, in the Coalville district, is to close down, and that the miners employed there have been given notice. This is the first mine in Leicestershire to feel the pinch of depressed trade to the extent of having to close down, though some of the pits have been working short time. The colliery has been in operation for about seventy years, selling the bulk of its coal, I understand, in the London market. The competition of Durham and Northumberland, the collieries in which are able, it is stated, to get the coal to the Metropolis cheaper by sea transport than the Midland collieries can by rail, has been very keenly felt, and Mr. R. H. Hyde-Thomson, the chairman of the Ibstock Colliery, now announces with regret that the present serious depression in the coal trade makes it impossible to carry on, and it is only after working at a serious financial loss for some considerable time, and after giving the matter much careful thought, that the directors have reluctantly decided that the working of the colliery must cease.

Use of Steel in Staffordshire Pits.

The report of Mr. H. A. Abbott, divisional inspector for the Midland and Southern Coalfields, remarks very favourably upon the increased use of steel arching for the support of the main roadways in the mines, making them safer and improving the ventilation. In North Staffordshire, where this form of support is more used than in other coalfields in the division, 117 miles of underground roadway are so safeguarded, arch steel girders being used over 43 miles.

Unemployment.

After showing consistent improvement, the returns recording the number unemployed in the Midlands give in the current total an increase of 9234 over the figure of last week, due to short time in some of the colliery areas. The total now stands at 187,457. Unemployment continues to decrease in the following Black Country towns : Birmingham, Bilston, Oldbury, Tipton, Wednesbury, Wolverhampton and at Stourbridge and Brierley Hill and Coventry.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

£3,000,000 Trunk Road.

A PROJECT that has been under discussion for about seven years has progressed very materially with the announcement at the last meeting of the Lancashire County Council that confirmation had been received from the Ministry of Transport to proceed with the construction of the Liverpool–Salford trunk road, the estimated cost of which is in the neighbourhood of £3,000,000. The scheme had been held up recently because the Manchester Ship Canal Company had instituted an action to restrain the Ministry of Transport from issuing a confirmation. This action, however, has since been withdrawn. The Chairman of the Main Roads and Bridges Committee of the Lancashire County Council, Alderman Aspell, hopes to be able to place tenders before either the February or March meeting of the Council for the construction of the length between the Liverpool boundary and Swinton. The remainder of the road will be from Swinton to Salford, a distance of only 3 or 4 miles. The new road forms part of a larger scheme for the construction of a trunk road across Lancashire and Yorkshire from Liverpool to Hull.

Locomotive Shop Dismissals.

The introduction of the most modern machinery into the Crewe locomotive shops of the London, Midland and Scottish Railway Company, combined with a shortage of work, has necessitated a reduction in the number of employees. It is reported that during the next month or so between 200 and 250 men, principally fitters and boilermakers, will receive notice. This is in addition to about 500, including a number who have retired owing to the reduction of the age limit from 70 to 65 years, who have ceased employment with the company during the past

eighteen months. Moreover, all apprentices are being dismissed on coming out of their time. With the new plant now installed it is stated that the overhaul of a locomotive can be completed in a period of about twelve days, instead of thirty or forty days which was necessary formerly, manual labour in a number of operations being reduced by half.

A Joint Electricity Board.

The Wilmslow and Alderley Edge Urban District Councils are purchasing the undertaking of the Wilmslow and Alderley Edge Electric Supply Company, and, in addition to supplying current to the areas concerned, are to supply a number of other local authorities in Cheshire. The Alderley Edge Council has decided to apply to the Ministry of Health for permission to borrow £113,000 for the purchase of the undertaking. The Electricity Commissioners have just issued a special order constituting a joint board consisting of representatives of the two Councils.

Fleetwood's New Sea Wall.

The high tides which were experienced on the west coast last week, the highest of the year, submitted the new sea wall at Fleetwood to a thorough test, through which it emerged successfully. Mr. S. Barron, the Assistant Surveyor, stated that throughout the entire length of the wall there was not a single breach or crack. When fully completed the wall will be 1900 yards in length, and will have cost about £55,000 to construct. It will be recalled that in October of last year, when the work had been begun, the high tides flooded the town and did very considerable damage.

First Civil Air Port.

The official sanction of the Air Ministry to the scheme for the establishment of an aerodrome at Chat Moss, Manchester, was received here on Tuesday of this week. A committee of the City Council has been appointed to carry out the details of the scheme.

The Lancashire Colliery Merger.

With the inclusion in the scheme of the Astley and Tyldesley Colliery Company, the merger of a number of the leading coal-mining concerns in Lancashire has been completed. The amalgamated concerns will be embraced in a new company, Manchester Collieries, Ltd., and, in addition to the Astley and Tyldesley Colliery Company, will include the Clifton and Kersley Coal Company, John Speakman and Sons, Andrew Knowles and Sons, Fletcher, Burrows and Co., as well as the numerous subsidiary undertakings of the various companies. Altogether, an annual production of 4,000,000 to 5,000,000 tons of coal, the product of twenty-two collieries, will be controlled by the new company. Mr. J. T. Browne, who is a director and general manager of Andrew Knowles and Sons, and who was elected this week President of the Lancashire and Cheshire Coal Association, will be a director and chief mining engineer of Manchester Collieries, Ltd.

Industrial Outlook.

In the course of a survey of the general industrial outlook locally, the official monthly journal of the Manchester Chamber of Commerce has the following reference to conditions in the engineering trades: Textile machinists have had a varying experience, some being well supplied with orders, while others have had insufficient work. Japan has continued her preparations for maintaining her output of textiles as far as possible when night-work by women is abolished. Indian mills' requirements have been small, owing to the prolongation of the great strike in Bombay until the first week of October, and no other market for textile machinery has been really active. Locomotive engineers have had an exceptionally busy time, and constructional engineers have generally been well engaged. Heavy electrical engineering firms have had a good deal of work in hand, but some of the smaller firms have been less fortunate. Machine tool makers generally have had a better trade, although there have been exceptions. A reference to conditions in the coal trade states that industrial fuel has had a poor market, owing to the short time in the cotton trade.

Non-ferrous Metals.

The tin section of the non-ferrous metals market during the past week has been the subject of considerable interest, not a little of which has been purely speculative in character. Up to the close of business last week, values had advanced to the extent of about £5 a ton since the position was last reviewed in this column. Some reaction in the early days of the present week brought prices back a little, although on balance current quotations are £4 a ton higher than they were a week ago. Buying operations on this side have been more active, and the market view at the moment seems to point to the likelihood, with perhaps occasional setbacks, of continued firm conditions. Throughout the greater part of the week there has been marked strength in the copper section also, and prices continued to rise, though less abruptly than in the previous week. As with tin, however, the highest point was not maintained, and largely in sympathy with United States advices, there has since been a setback which has brought current values for standard metal down to about 10s. a ton below the levels quoted a week ago, although refined descriptions are appreciably firmer. Here, again, a much larger quantity has changed hands. In spite of a fair degree of activity in the lead market, bigger supplies of Australian metal had a bearing influence on the market, and the first serious reaction for several months was experienced, the fall being equivalent to about 15s. a ton on the week. There has been a slightly improved demand about for spelter and values have firmed up a little.

Iron and Steel.

A few forward contracts for pig iron have been placed here this week, but in a number of instances makers are complaining of the sluggish flow of specifications against contracts already on the books. On the whole, however, stocks of iron at the furnaces are not excessive, and there has been no giving way of prices, Staffordshire No. 3 being quoted at 67s. 6d., Derbyshire at 68s., Middlesbrough at 79s., Scottish at 87s. 6d. upwards, and hematite iron at 82s. per ton, all for delivery Manchester or equal distance. It is obvious that, with few exceptions, conditions at the foundries locally leave a good deal to be desired. With regard to manufactured iron, trade in this section shows little improvement, but Lancashire Association prices are well held at £10 per ton for Crown quality bars and 10s. less for seconds. In the steel market boiler plates have attracted little attention this week apart from a few orders for odd lots. A quietly steady business is being done, however, in constructional products, and also in steel bars and quotations are firm all round, with boiler plates at £9 10s. to £9 15s.; small bars at £7 17s. 6d. to £8; sections at £7 17s. 6d.; ship and tank plates at £8 12s. 6d.; and large bars at £8 17s. 6d. The German steel works trouble has not actually influenced prices of foreign materials here so far, except in the case of billets and sheet bars, which, however, are purely nominal, because of the greater difficulty in securing supplies. In other respects the market for imported steel is very quiet.

BARROW-IN-FURNESS.

Hematite.

The pig iron market in the north-western district continues to be steady. There have been no signs of a further spurt, but, on the other hand, there is no sign of a falling off as was feared by a few. At present the output in the district is being absorbed, one of the factors being the fair tonnage which the steel departments are taking every week. Should the steel departments stop, then there will be more iron to sell, and the question is, where will it go? There might be a better trade with the Continent or America, should there be an overmake locally. There is no news of any more furnaces going into blast, and there is hardly likely to be unless it be at Cleator, where large stocks had accumulated. On the other hand, the works at Ulverston might meet the demand, for they are controlled by the same company. Business in special qualities continues steady. At present the overseas trade is dull. There is nothing fresh to report about the iron ore trade, which continues to be steady. The steel market is dull, orders are few, and the competition is keen. Fresh orders are urgently needed locally, for there is only about two weeks' work to complete contracts for railway material at Barrow. The hoop works are much better circumstanced and steady running is assured.

SHEFFIELD.

(From our own Correspondent.

Steel Trade Conditions.

THERE is little change to report in the state of things in the local steel trades. What alteration has taken place since my last report has been on the unsatisfactory side, as the heavy crude steel branches have had a quiet week as regards the booking of new business. It is still those branches, however, which are showing activity, and they are busy on orders previously placed. The decline of continental competition has been of considerable value to local firms, though not as much as was expected. If the present labour troubles in Germany develop, as seems possible, Sheffield will stand to gain a good deal. There is still an unsatisfactory demand for the best acid steels, which are difficult to dispose of, at any rate in large quantities. The rolling mills and forges are somewhat better employed, but are still on short time. The railway steel plants are only moderately engaged. Some of them have a fair amount of work on hand from overseas, but the home railway companies are continuing their economical policy. Basic steel scrap is in good request, with prices firm.

Tool Steels and Tools.

There is only a moderate demand for best tool steels, but sales are maintaining their recent levels. The individual orders, though mostly small, are numerous. German high-speed steels compete very keenly with those of Sheffield in overseas markets, and in order to obtain business prices of British material have to be severely cut. An improvement is to be noted in the tool trades. Orders are now coming in on a considerable scale, and although work is not sufficient to go round, there is certainly a better tendency, both at home and abroad. This remark does not apply to plantation tools, the call for which shows a falling off. The file trade is less depressed than it has been for some time past.

Redbourne Hill.

One or two furnaces at the Redbourne Hill Works, Scunthorpe, are being prepared for gassing, but the report that it was proposed to instal tin-plate mills at the works has been officially denied.

Contract for Water Mains.

Hastings Town Council has accepted the tender of the Stanton Ironworks Company to supply cast iron pipes for water mains, at the figure of £13,515. An interesting point about the matter is that the Stanton tender was about £1000 in excess of one from France, but the Hastings Council Committee took the view that it was essential to take home-produced goods at a little sacrifice in view of the large amount of unemployment in this country.

Cutlery and Plate.

The cutlery and plate trades report a considerable increase in the demand for medium and cheap goods, as a result of which activity has shown a substantial improvement during the past week or two. The sale of stainless cutlery is well maintained. There is a good demand for cutlery and plate of the best quality, and some firms specialising in this grade report an improved trade, but the total quantity being called for is not up to the averages of past years. The delivery of goods intended for the Christmas trade in Australia has been hampered by labour troubles at the ports.

A Two-storied Depot.

Sheffield Corporation has adopted a novel idea in the arrangement of a large new depôt for tramcars and motor omnibuses, part of which the builders have now handed over. It consists of two stories, the ground floor being for tramcars and the upper one for omnibuses. The ground floor was taken into use last week, and will accommodate eighty to eighty-five tramcars in twenty-four bays. The upper floor will have a holding capacity of 100 omnibuses.

Hull Improvements.

Greatly increased facilities for the fishing industry are being provided at St. Andrew's Dock, Hull, by the London and North-Eastern Railway Company, which is constructing a covered landing stage at an estimated cost of £100,000. One-third of the new stage has now been brought into use. This section consists of 500ft. of staging, out of a total length of 1400ft., and has been constructed by the dock engineer's department well within the scheduled time. It is expected that 200ft. more will be completed in time for the Easter market. The landing stage is of concrete. What was known as the herring stage has had its width increased by nearly 30ft. Railway lines have been moved in order to permit of the extension, and a new roadway has been made. There are two tiers of offices for merchants and their staffs. The handling and dispatch of fish will be greatly facilitated by the new stage. The fish will be landed from trawlers on one side, and, after sale and packing, will be loaded into railway trucks on the other side. The Hull Corporation has decided to make a further effort to bring about the abolition of the city's level crossings, which bisect five main roads and cause much delay and disorganisation to road traffic. A special committee has been appointed to renew negotiations with the London and North-Eastern Railway Company, with a view to ascertaining the amount which it would be prepared to contribute towards the work. A scheme was formulated in 1925, when the railway company offered to pay £100,000, which was not considered adequate. The Corporation was prepared to find £250,000, but as the whole cost of the scheme would be £1,150,000, £800,000 would have been left to be provided by the Ministry of Transport, which was not prepared to pay so great a share.

NORTH OF ENGLAND.

(From our own Correspondent.)

Steel Trade Revival.

THE lock-out of iron and steel workers in Germany is attracting a good deal of attention in the North of England. As yet the event has had little influence upon the position in this area, and producers are not building up extravagant hopes of a diversion of iron and steel orders, but they generally realise that the dispute, if prolonged, is bound to have a beneficial effect upon English industry. For some years past, Germany has been one of Cleveland's most formidable competitors, and many overseas markets have been lost to that country. This applied more particularly to pig iron and semi-finished steel. The pendulum, however, has recently been swinging in favour of Cleveland as well as other British producers, and not only are prices now on a competitive level but there are indications of increased activities at Northern works consequent upon an improved demand from overseas for steel manufactures. An important factor is the contention of German makers that they cannot shoulder any further additions to their production costs if they are to compete successfully in the world's markets. Costs in this district have been gradually falling, and manufacturers will receive further relief at the beginning of next month, when the reduced railway freights come into operation. Still later they will benefit from de-rating. Thus, the situation generally is moving in favour of British producers.

Iron and Steel Exports Up.

In the meantime, it is encouraging to record an increase in the iron and steel exports from the Cleveland district during October. Pig iron exports, however, still leave room for considerable improvement. Cleveland producers are experiencing keen competition from the Midlands, especially in the Scottish market. Thus the coastwise shipments of pig iron last month only reached 7863 tons, which is the smallest total of the year, but foreign shipments advanced from 8500 tons to 8911 tons. The steel works, however, are experiencing a welcome revival in the overseas demand for material, and, except in June last, there has not been so much manufactured iron and steel shipped from Cleveland in any month this year as was the case in October. In June the steel tonnage shipped was 68,778; in October it was 68,506, as compared with only 49,257 tons in September. India and Ceylon were again the best customers, their share being 21,261 tons, which is the biggest total recorded since July, 1927. African ports received 12,667 tons, compared with 6291 tons in September, whilst an encouraging advance in the South American trade is revealed in the shipment of 9572 tons of material to Peru and Argentina.

Imports Still Dwindling.

Another encouraging feature is the continued marked contraction in imports. Statistics presented at this week's meeting of the Tees Conservancy Commissioners showed that during October 13,897 tons of iron and steel were imported, or less than half the quantity received in the corresponding month of last year, and a drop of nearly 3000 tons compared with the figures for September. For the twelve months ended October 222,430 tons were imported, as against 382,514 tons in 1926–27 and 54,564 tons in the pre-war years 1913–14. The pig iron unloaded during the twelve months totalled only 7082 tons, as com-

pared with 105,567 tons in 1926–27 and 1427 tons in 1913–14. The imports of crude sheet bars, billets, blooms, slabs, &c., amounted to 167,758 tons, as compared with 220,837 tons and 33,655 tons, and plates, bars, angles, rails, sheets, joists, &c., to 47,590 tons, as against 56,110 tons and 19,482 tons.

Cleveland Iron Trade.

Business in Cleveland pig iron still continues on the slow side, but apart from the increased demand which the turn of events in Germany may create, transactions are expected to be more numerous in the very near future, as customers have still to make considerable purchases to cover their needs for this year. The restricted make of Cleveland pig iron is largely absorbed at works owned by producers, who report that they are getting rid of the limited surplus available for disposal on the open market. Stocks keep low, and producers adhere to fixed prices. No. 1 foundry is 68s. 6d.; No. 3 G.M.B., 66s.; No. 4. foundry, 65s.; and No. 4 forge, 64s. 6d.

Hematite Pig Iron.

East Coast hematite pig iron is now scarce. Stocks are exhausted, and the limited make is fully taken up by home and continental consumers. Makers have no arrangement fixing prices. While quotations are a matter of individual bargaining, and consequently vary somewhat, it is difficult to place orders at less than the basis of 70s. for ordinary qualities, though the competition of West Coast makers is as keen as ever.

Ironmaking Materials.

There is very little activity in foreign ore, but merchants are busy overtaking arrears of delivery under old contracts, and with freights firm and ore supplies likely to be anything but plentiful, quotations are upheld at the equivalent of best Rubio ore at 22s. 6d. c.i.f. Tees. Sellers of good medium blast-furnace coke hold firmly to 17s. 9d. delivered at the works, but consumers are disinclined to enter into contracts at the price.

Manufactured Iron and Steel.

The manufactured iron and steel trade maintains a very fair tone, with continental competition weak, and consumers outside the British manufacturers' rebates scheme are faced with the possibility of encountering new handicaps. The steel works are busily employed in certain branches, but in other departments producers are anxious to arrange contracts. Semi-finished steel makers are better placed than for a long time past. Prices are firmly maintained.

The Coal Trade.

The Northern coal trade has entered upon a rather promising period. Inquiries are keeping pace with the improving conditions in the trade generally. Most of the Northumberland pits are working very regularly, and are likely to do so for an indefinite time, and in Durham there are certain collieries which are so well sold as to have only a moderate amount of output to offer right into the first half of next year. This brighter state of things is gradually developing without the aid of marketing or quota schemes, and is no doubt much to be preferred to artificial restoratives, which invariably have their drawbacks and inconveniences to producers. Best Northumberland steam coals are being fully taken up and prices are firmly held at 14s. to 14s. 3d., with seconds at 12s. 9d. to 13s. If steam smalls showed more animation, the Northumberland collieries would be in the best all-round position they have known this year. Demand, however, is weak, and prices are very easy at 8s. to 8s. 6d. Durham gas coals are difficult to get for the remainder of the year, and producers ask a firm 14s. 9d. to 15s. Specials and seconds keep to late prices. Coking coal buying is dull at the moment, and bunkers are not particularly active. Makers of gas coke are well sold, but contractors have been able to secure sufficient tonnage for prompt clearances, and consequently offer supplies for early clearance at a weak 19s. 6d., but forward all holders ask from 20s. to 20s. 6d. Patent oven cokes are steady, and, despite ample supply, command a full 18s. 3d. to 19s. Beehive and foundry cokes are in quiet demand, but firm at 23s. 6d. to 28s. 6d.

Important Shipbuilding Orders.

An important contract for a 15,000-ton floating oil factory has been secured by Swan, Hunter and Wigham Richardson, Ltd., Wallsend, from the Viking Whaling Company. The contract price for the ship is about £275,000, and the vessel will occupy many months in construction and employ a large number of men. The vessel will be specially constructed to withstand ice pressure, and will be equipped with a considerable amount of plant for dealing with whale oil. Palmers' Shipbuilding and Iron Company has booked an order from American owners for a steamer to carry about 2000 tons of cargo. The order also includes the engines, which will be constructed at the Jarrow engine works of the firm. The Northumberland Shipbuilding Company is to lay down a third vessel for the Court Line, which will be the first motor ship built at the yard and the first motor vessel in the owners', fleet.

SCOTLAND.

(From our own Correspondent.)

Shipbuilding : Output Decline.

During the first nine months of this year the monthly output from Clyde shipyards was maintained at a high level, and there seemed a possibility that a record year's output would be established. On the other hand, the dearth of new business over a considerable period promised a sudden drop in production when contracts on hand diminished, as berths were being vacated at a much greater rate than they were being occupied by new keels. Returns for October put an end to all hopes of a record year, as only eight vessels of 12,835 tons aggregate were launched. Consequently with this drop in output there is now a considerable adverse balance for the ten months this year compared with the maximum for the period. The October output was almost wholly accounted for by the launch of the motorship "Staffordshire," 10,800 tons, built for the Bibby Steamship Company, Ltd., Liverpool.

Shipbuilding Contracts.

Contracts announced during October were, with the exception of three cargo steamers of 6400 tons and two of 7200 tons, mostly for small craft, and therefore considerable satisfaction has been caused by the placing of the contract for the new C.P.R. Liner "Empress of Britain," with John Brown and Co., Ltd., Clydebank. This new liner, of 40,000 tons, will be the second largest constructed on the Clyde, the largest, of course, being the "Aquitania."

Steel and Iron.

While there has been a broadening out in inquiries for steel and iron products actual business does not yet show material expansion. Heavy steel makers require fresh business, especially for shipbuilding materials. Export orders have increased somewhat, but not sufficiently to make up for the lack of the home trade. Light steel sheets are busy, especially galvanised varieties. Tube makers are busy, but it may be noted that during the past few days tube hoops have been advanced by 2s. 6d. per ton for 12in. to 16in. wide, the price now being £6 12s. 6d. f.o.b. Antwerp. Bar iron continues depressed, but re-rollers are slightly busier. Pig iron is quiet but steady.

Coal.

The position has improved somewhat with an expansion in home demands and a better shipping outlet. Outputs are restricted and prices, as a rule, are firm. Best Lanarkshire splints are firmer and ells fully maintain their position. Best Fifeshire steams are very well sold, and with third-class qualities are difficult to secure for prompt shipment. Lothians steams are moving off regularly. In all districts, but especially in Fifeshire, treble nuts are particularly firm, while doubles have improved. Smaller sizes are inactive. Aggregate shipments amounted to 219,218 tons, against 257,510 tons in the preceding week and 265,942 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

While there is room for very considerable improvement in the conditions in the steam coal industry, this much can be said, that they are at the moment rather better than they have been recently. The great trouble of the last few weeks has been the shortage of tonnage, and though supplies are still below requirements, the position this week is that the docks are more actively engaged. At the end of last week there were thirty-eight idle tipping appliances, but as the result of arrivals over the week-end this figure was reduced to thirteen, and there were eight steamers waiting to get into berth. This is a distinct improvement, but it does not, unfortunately, mean that all collieries are working more regularly or that prices are appreciably better. There is a prospect, however, that the improvement which has been registered will be maintained for a time at least, as chartering has been more active consequent upon the advance in freight rates, which appear to have about reached the top level. The inquiry for tonnage continues to be moderately good, and it is evident that merchants are holding a fair number of orders which have not been disclosed. As regards contract business, it is reported that the Brazilian Central Railway has placed its order for about 200,000 tons of large and small coals with Cory Brothers and Co., Ltd., at the price of 27s. 10d. c.i.f. Rio de Janeiro, the coals being for delivery over four months from December. Unfortunately, the Algerian State Railways' order for 210,000 tons of patent fuel and 30,000 tons of coals has been lost to South Wales. Local firms have been undercut by French patent fuel manufacturers, but this is not surprising, but the coal business has been placed with Polish Silesian collieries. An order for 10,000 tons of sized coals for delivery at Casablanca has also been lost to French collieries. In some directions there is a feeling of annoyance, as it is contended that but for the rigid adherence to minimum prices this and other business would have been secured for South Wales. However, it is understood that the British Admiralty is in the market for its requirements over next year. What quantity it will take it is difficult to say, but it is reported that the quantity is likely to be round about 300,000 tons or 400,000 tons. The Norte Railways of Spain are also inquiring for 40,000 tons of large coals for fairly early delivery, and the Palestine Railways are in the market for 18,000 tons of large coals for delivery at Haiffa. Prices are also wanted by the 21st inst. for 46,000 tons of semi-bituminous unwashed steam smalls for delivery over four months to the Bristol Corporation Electricity Department.

Control of Coal Production.

Reference was made a week ago to the question of the control, not only of coal prices, but of production as well in this district. Instead of there being a prospect of a definite breakdown in the voluntary scheme now in operation, the Executive Committee has been engaged on the problem of tightening up the scheme so as to bring the production of coal more into line with market requirements and so further to strengthen the conditions. It is understood that the committee has made considerable progress with the new scheme, and that there is a good prospect of its being brought into operation from the beginning of next year. In its main details it is reported that the scheme is very similar to that which has been in force in Germany for more than thirty years.

Docks Facilities.

The Great Western Railway Company, which recently provided three new 3-ton hydraulic cargo cranes at the Roath Dock, Cardiff, has now brought into operation important new facilities at the Swansea Docks. The mole which juts into the east end of the King's Dock has been developed into two new general cargo berths. The mole is 680ft. in length and 141ft. in width, and on it the company has erected a two-storey transit shed 352ft. long and 75ft. wide, equipped with two 4-ton gantry cranes on the ground floor and eight 3-ton electric luffing cranes on the quay, four at each side of the shed, thus providing two new additional berths for cargo steamers. The shed was built by Sir William Arrol and Co., and the cranes were erected by Stothert and Pitt and Holt and Willetts, Ltd.

Steel Trade.

A meeting of the Joint Standing Committee of the Siemens Steel Trade Joint Conciliation Board will, it is understood, be held on the 9th inst. at Swansea, when a number of claims by the men will be considered, particularly one requesting that the basis of the sliding scale shall be reduced from £5 to £4. In the event of this being conceded, it will mean an immediate advance to a number of the highest paid grades of workmen covered by the sliding scale.

Current Business.

Quite a number of collieries are this week better situated by reason of the fact that tonnage in dock has improved and there is more loading activity. At the same time standing stocks are so heavy that there is no difficulty in meeting all requirements, and the demand is not as yet good enough to have any beneficial influence on prices. Large coals of all descriptions are easily obtainable, though the supply of smalls is relatively less and the market is steadier. Shipments last week reached a total of nearly 460,000, as compared with just over 400,000 tons in the previous week, and there is just a chance that this improvement will be upheld this week. Coke and patent fuel are quiet, but pitwood is steady round about 31s.

CONTRACTS.

The Consolidated Brake and Engineering Company, Ltd., has received from the Glasgow Corporation an order for 300 sets of air brake equipment for tramcars.

The Brown-Boveri organisation has received an order for the four new 20,000-kW steam turbines with condensing plant and auxiliaries for the Schaerbeek power station, Brussels. The machines are to be of the three-cylinder pattern, designed for live steam at 525 lb. per square inch gauge at about 800 deg. Fah.

Richard Garrett and Sons, Ltd., of Leiston and Aldwych House, Aldwych, London, W.C. 2, have received a repeat order from the National Electric Construction Company, Ltd., of Salisbury-square House, Salisbury-square, London, E.C. 4, for a further twelve "Garrett" single-deck electric trolley omnibuses for the Mexborough and Swinton tramways.

Alfred Herbert, Ltd., asks us to announce that its American licensee, the Riley Stoker Corporation, has recently secured orders for a total of six Atritors from the E-Z Opener Bag Company, of Braithwaite, La.; the Imperial Laundry, Newark, N.J.; the Marine Barracks, Quantico, Va.; the Towanda Paper Company, N.J.; and the Marblehead Lime Company, Chicago.

The Central Electricity Board has placed contracts, amounting in all to more than £600,000, for the supply and erection of the 132,000-volt outdoor switchgear included in the South-East England electricity scheme, 1927, as follows:—For Part I., covering the northern portion of the area, with A. Reyrolle and Co., Ltd., and for Part II., covering the southern portion of the area, with the English Electric Company, Ltd.

PERSONAL AND BUSINESS ANNOUNCEMENTS.

The Mond Nickel Company, Ltd., asks us to announce that on and after Monday, November 12th, 1928, the head office of the company will be at Imperial Chemical House, Millbank, London, S.W. 1. The telephone number will be Victoria 4444 and the telegraphic address "Nictatio, Phone, London."

Wild-Barfield Electric Furnaces, Ltd., asks us to announce with regard to the notice which was published some time ago that the Robert T. Pollock Company, of New York, had taken over the American patent rights of the Wild-Barfield electric furnaces, that it was recently approached by the Hevi-Duty Electric Company, of Milwaukee, Wisconsin, which desired to negotiate with the Robert T. Pollock Company and it for the sole rights of Wild-Barfield furnaces in the United States of America and Canada. Arrangements have now been made with both parties concerned, and in future the Hevi-Duty Electric Company will manufacture and sell in the countries named.

Reunion of Ex-National Telephone Company Officials.—An opportunity is being offered for past members of the Ex-National Telephone Company's staff to meet together on Monday, December 10th, 1928, at 7 p.m., at the New Criterion Restaurant, Piccadilly Circus. The chairman of the Arrangements Committee is Lieut.-Colonel C. B. Clay, V.D., and the hon. secretary is Mr. T. A. Prout, 17, The Chine, N. 21, who will be pleased to supply further information and to receive applications for tickets.

The Council of the National Lubricating Oil and Grease Federation informs us that it is so gravely concerned with the growing practice on the part of various Corporations and Councils throughout the country of issuing tender forms for contracts for the supply of lubricating oils, greases and stores which contain clauses which are in many cases grossly one-sided in character and which defeat the object of a contract between two parties, that it has decided to draw the attention of the various Councils and similar associations to the unfair conditions prevailing. Contracts, it says, are naturally so competitive and prices are consequently so keenly cut that the contractor should be entitled to a fixed undertaking without invidious conditions being imposed; in other words, the terms of the contract should not be all on one side. The Council also condemns the almost universal policy at the present day of accepting the lowest prices and ignoring the standard of quality indicated in tender forms.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. Coast—	
(1) Native	18/- to 21/6
(1) Spanish	18/- to 22/6
(1) N. African	18/- to 22/6
N.E Coast—	
Native	18/- to 21/-
Foreign (c.i.f.)	22/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) Scotland—		
Hematite	3 14 0	—
No. 1 Foundry	3 15 0 to 3 16 0	—
No. 3 Foundry	3 11 0	—
N.E. Coast—		
Hematite Mixed Nos.	3 10 0	3 10 0
No. 1	3 11 0	3 11 0
Cleveland—		
No. 1	3 8 6	3 8 6
Silicious Iron	3 8 6	3 8 6
No. 3 G.M.B.	3 6 0	3 6 0
No. 4 Foundry	3 5 0	3 5 0
No. 4 Forge	3 4 6	3 4 6
Mottled	3 4 0	3 4 0
White	3 4 0	3 4 0
Midlands—		
(3) Staffs.—		
All-mine (Cold Blast)	—	—
North Staffs. Forge	—	—
,, ,, Foundry	3 2 6	—
(3) Northampton—		
Foundry No. 3	2 17 0 to 2 18 0	—
Forge	2 13 6	—
(3) Derbyshire—		
No. 3 Foundry	3 0 0 to 3 1 0	—
Forge	2 16 0	—
(3) Lincolnshire—		
No. 3 Foundry	3 0 0	—
No. 4 Forge	2 17 6	—
Basic	2 19 0	—
(4) N.W. Coast—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 0 0 (a) / 4 2 6 (b) / 4 5 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
Scotland—		
Crown Bars	10 5 0	9 15 0
Best	—	—
N.E. Coast—		
Iron Rivets	11 5 0	—
Common Bars	10 5 0	—
Best Bars	10 15 0	—
Double Best Bars	11 5 0	—
Treble Best Bars	11 15 0	—
Lancs.—		
Crown Bars	10 0 0	—
Second Quality Bars	9 10 0	—
Hoops	13 0 0	—
S. Yorks.—		
Crown Bars	10 10 0	—
Best Bars	11 0 0	—
Hoops	12 10 0	—
Midlands—		
Crown Bars	9 2 6 to 10 0 0	—
Marked Bars (Staffs.)	12 0 0	—
Nut and Bolt Bars	8 12 6 to 8 17 6	—
Gas Tube Strip	10 15 0 to 10 17 6	—

STEEL. (d)

	(6) Home. £ s. d.	(7) Export £ s. d.
(5) Scotland—		
Boiler Plates	10 10 0	10 10 0
Ship Plates, ¼in. and up	8 7 6	7 12 6
Sections	7 17 6	7 2 6
Steel Sheets, ¼in.	8 15 0	8 12 6
Sheets (Gal.Cor. 24 B.G)	13 10 0 .. 13 12 6 to 13 15 0	

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. Coast—		
Ship Plates	8 7 6	—
Angles	7 17 6	—
Boiler Plates	12 15 0	—
Joists	7 17 6	—
Heavy Rails	8 10 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	7 12 6	—
Soft Billets	6 15 0	—
N.W Coast—		
Barrow—		
Heavy Rails	8 0 0	—
Light Rails	8 5 0 to 8 10 0	—
Billets	6 15 0 to 9 15 0	—
Manchester—		
Bars (Round)	8 17 6	—
,, (Small Round)	7 17 6 to 8 0 0	—
Hoops (Baling)	10 0 0	9 15 0
,, (Soft Steel)	9 0 0	8 15 0
Plates	8 12 6 to 8 17 6	—
,, (Lancs. Boiler)	9 10 0 to 9 15 0	—
Sheffield—		
Siemens Acid Billets	9 5 0 to 9 10 0	—
Hard Basic	7 2 6 and 7 12 6	—
Intermediate Basic	7 0 0	—
Soft Basic	6 10 0	—
Hoops	9 0 0	—
Soft Wire Rods	7 5 0 to 7 10 0	—
Midlands		
Small Rolled Bars	7 15 0 to 8 0 0	—
Billets and Sheet Bars	6 7 6 to 6 10 0	—
Sheets (20 W.G.)	11 10 0 to 12 0 0	—
Galv. Sheets, f.o.b. L'pool	13 10 0 to 13 15 0	—
Angles	7 17 6	—
Joists	7 17 6	—
Tees	8 17 6	—
Bridge and Tank Plates	8 12 6	—
Boiler Plates	11 0 0	—

NON-FERROUS METALS.

Swansea—	
Tin-plates, I.C., 20 by 14	18/- to 18/3
Block Tin (cash)	230 7 6
,, (three months)	222 5 0
Copper (cash)	67 11 3
,, (three months)	68 1 3
Spanish Lead (cash)	21 6 3
,, (three months)	21 11 3
Spelter (cash)	24 5 0
,, (three months)	24 5 0
Manchester—	
Copper, Best Selected Ingots	73 10 0
,, Electrolytic	75 5 0
,, Strong Sheets	98 0 0
,, Tubes (Basis Price), lb.	0 1 1½
Brass Tubes (Basis Price), lb.	0 1 0½
,, Condenser, lb.	0 1 2½
Lead, English	23 0 0
,, Foreign	21 15 0
Spelter	24 7 6
Aluminium (per ton)	£137

FERRO ALLOYS.

	Per Ton.	Per Unit.
Tungsten Metal Powder	1/8 per lb.	
Ferro Tungsten	1/3 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£21 10 0	7/6
,, ,, 6 p.c. to 8 p.c.	£20 10 0	7/-
,, ,, 8 p.c. to 10 p.c.	£20 0 0	6/-
,, ,, Specially refined		
,, ,, Max. 2 p.c. carbon	£33 0 0	12/-
,, ,, ,, 1 p.c. carbon	£37 0 0	15/-
,, ,, ,, 0·70 p.c. carbon	£41 0 0	17/-
,, ,, ,, carbon free	1/- per lb.	
Metallic Chromium	2/7 per lb.	
Ferro Manganese (per ton)	£13 15 0 for home; £13 10 0 for export	
,, Silicon, 45 p.c. to 50 p.c.	£12 0 0 scale 5/- per unit	
,, ,, 75 p.c.	£19 0 0 scale 6/- per unit	
,, Vanadium	14/- per lb.	
,, Molybdenum	4/3 per lb.	
,, Titanium (carbon free)	1/2 per lb.	
Nickel (per ton)	£170 to £175	
Ferro-Cobalt	9/- per lb.	

FUELS.

SCOTLAND.

(*Prices not stable.*)

	Export.
Lanark-shire—	
(f.o.b. Glasgow)—Steam	13/9
,, ,, Ell	16/-
,, ,, Splint	16/- to 16/9
,, ,, Trebles	14/6 to 15/-
,, ,, Doubles	13/9 to 14/-
,, ,, Singles	12/3
Ayrshire—	
(f.o.b. Ports)—Steam	13/6
,, ,, Jewel	15/6
,, ,, Trebles	15/6 to 16/-
Fifeshire—	
f.o.b. Methil or Burntisland—Steam	12/9 to 13/6
Screened Navigation	18/-
Trebles	15/6 to 16/6
Doubles	13/6
Singles	12/9
Lothians—	
(f.o.b. Leith)—Best Steam	13/-
Secondary Steam	12/6
Trebles	15/- to 15/6
Doubles	13/6
Singles	12/9

ENGLAND.

(8) N.W. Coast—	
Steams	25/6
Household	38/6 to 51/-
Coke	22/6 to 23/6
Northumberland—	
Best Steams	14/-
Second Steams	13/- to 13/6
Steam Smalls	9/- to 9/6
Unscreened	11,9 to 12/-
Household	21/- to 27/-
Durham—	
Best Gas	14/9
Second	13/- to 13/3
Household	21/- to 27/-
Foundry Coke	18/6 to 19/6

Sheffield—	Inland.	Export.
Best Hand-picked Branch	26/- to 27/6	—
Derbyshire Best Bright House	23/- to 24/6	—
Best House Coal	20/6 to 21/6	—
Screened House Coal	17/- to 18/-	—
,, ,, Nuts	16/- to 18/-	—
Yorkshire Hards	14/6 to 16/-	—
Derbyshire Hards	14/6 to 16/-	—
Rough Slacks	8/6 to 9/6	—
Nutty Slacks	4/6 to 6/-	—
Smalls	3/6 to 4/-	—
Blast-furnace Coke (Inland)	13/6 at ovens	—
Furnace and Foundry Coke (Export), f.o.b.		19/- to 19/6

(9) SOUTH WALES.

Cardiff—	
Steam Coals :	
Best Smokeless Large	19/3 to 19/6
Second Smokeless Large	18/- to 19/3
Best Dry Large	17/9 to 18/6
Ordinary Dry Large	17/ to 17/3
Best Black Vein Large	17/6 to 17/9
Western Valley Large	17/- to 17/3
Best Eastern Valley Large	16/6 to 17/-
Ordinary Eastern Valley Large	16/3 to 16/6
Best Steam Smalls	12/6 to 13/-
Ordinary Smalls	10/6 to 12/-
Washed Nuts	18/- to 20/-
No. 3 Rhondda Large	19/6 to 20/-
,, ,, Smalls	14/- to 14/6
No. 2 ,, Large	16/- to 16/6
,, ,, Through	14/6 to 15/6
,, ,, Smalls	11/- to 12/-
Foundry Coke (export)	27/- to 37/-
Furnace Coke (export)	19/- to 21/-
Patent Fuel	20/- to 21/6
Pitwood (ex ship)	30/6 to 31/6
Swansea—	
Anthracite Coals :	
Best Big Vein Large	34/- to 35/6
Seconds	24/6 to 28/6
Red Vein	22/- to 27/-
Machine-made Cobbles	40/- to 43/6
Nuts	36/- to 43/6
Beans	23/6 to 25/-
Peas	18/- to 18/6
Breaker Duff	8/- to 8/6
Rubbly Culm	10/9 to 11/3
Steam Coals :	
Large	17/6 to 18/6
Seconds	16/- to 17/-
Smalls	12/- to 12/6
Cargo Through	15/- to 16/-

(1) Delivered. (2) Net Makers' Works. (3) f.o.t. Makers' Works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire and Ayrshire.

(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. (a) Delivered Glasgow. (b) Delivered Sheffield. (c) Delivered Birmingham. (d) Rebate 12/6 joists and 10/- all other materials if home consumers confine purchases solely to British products.

French Engineering Notes.

(From our own Correspondent in Paris.)

Railways and Waterways.

So long as railways were under State control, or were assisted financially by the State, the competition of inland waterways was not regarded as a serious matter, as it really affected no one but the taxpayer. The whole country paid for the benefit of a section of the community. It also paid for the railways for purposes of national defence. When the State found that the public funds, which had been making up for railway deficits, was required for other purposes, the companies were left to their own resources, and the competition of inland waterways therefore assumed a much more serious character. The railway companies could do nothing, because the economic value of the inland waterway system is too generally recognised to permit of any attempt being made to restrict its development, and the construction of canals and the canalising of rivers are amongst the most important schemes of public works that are now being put in hand. Cheap transport is to be secured by an ample and efficient system of waterways. As they can do nothing against this competition, the railway companies are endeavouring to co-operate with the waterways in the hope of benefiting from the development of traffic, in the same way that they are seeking to work in collaboration with road motor vehicle services. The French railways are, nevertheless, favoured by the long distances which have to be covered, whereby they must necessarily deal with all heavy traffic to be effected within reasonable time limits. In Belgium the situation is far more precarious for the railways, since the distances are short; and now that the railways are worked by a company without help from the State, the competition of the waterways has become extremely embarrassing. The railway company has been endeavouring to secure a monopoly of transport on the ground that the competition of the inland waterways is unfair because they are not burdened with the same heavy charges, but the navigation concerns have issued a long report refuting the claims of the railway company, and the whole matter is to be thrashed out at a Congress which has just been opened in Brussels.

Reinforced Concrete.

Confidence in reinforced concrete has again been shaken by the collapse of yet another building which was nearing completion in a street off the Champs Elysées. It was a huge five-storey building designed to be laid out partly as a theatre, and the whole of it fell in late one evening when there was, fortunately, no one about. On this occasion there was no lack of technical supervision, for three architects were employed on the work; but nevertheless a first investigation led to the conclusion that the collapse was due to the haste with which building operations were carried on. The walls up to the first floor withstood the crash, but much of the concrete above smashed into fragments, the failure being attributed by some experts to the shuttering having been removed before the concrete had quite set. There is no tendency to incriminate reinforced concrete as a building material, but the impression is general that there has been a too sudden change to it from stone and iron, and that a vast amount of building has been carried on with it in ignorance of the conditions under which it can be safely employed. The whole matter is being taken up seriously, and it is intended to impose severe regulations to ensure that reinforced concrete buildings are constructed with a due regard to the quality of the material and the conditions under which it is used.

An Inexplicable Wreck.

While there is as yet no conclusive evidence that the sinking of the "Numidia" in the Port of Marseilles was due to a criminal act, there is nevertheless a tendency to associate the loss of the ship with the strike of seamen which had been settled a few days previously. There is, of course, no shadow of suspicion on the seamen as a body, but the circumstances under which the sinking took place have caused no little uneasiness. The "Numidia," belonging to the Compagnie Fraissinet, was employed in the service between Marseilles and Corsica. Though built as long ago as 1904, it was entirely overhauled and repaired last year, and was in perfectly good condition. During the night previous to its departure on a voyage, when there were only a few hands on board, the ship was found to be sinking, and despite the efforts to keep the water under with pumps, it sank to the bottom, leaving the deck awash. Divers are now endeavouring to ascertain how the sinking could have occurred.

Paris Traffic.

The traffic in the centre of Paris has reached such a state of intolerable congestion that there can be no remedy beyond some drastic measures which will provide a larger number of channels of communication. The Paris Municipal Council is examining many schemes, not only for dealing with the traffic, but also for decongesting the city by modernising constructions and extending the city outwards; but, as there can be little hope of this vast urban transformation being started upon in the early future, the chance of doing anything to deal with the traffic problem lies in the construction of underground roadways. Many such schemes have already been proposed and rejected on account of obvious drawbacks, but a new proposal is now under consideration for constructing three great transversal underground roadways which will connect up the northern part of the city with the left side of the Seine. They will follow the lines of existing thoroughfares and will provide a double road track and two footways, with outlets for passengers, while under the Tuileries Gardens it is proposed to lay out a vast space for parking cars. Already it has been decided to provide underground parking accommodation in front of the Bourse. Plans have also been made for the complete transformation of the City, with huge blocks of buildings in residential, business and industrial zones, and the continuation of the town in the direction of Saint-Germain.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

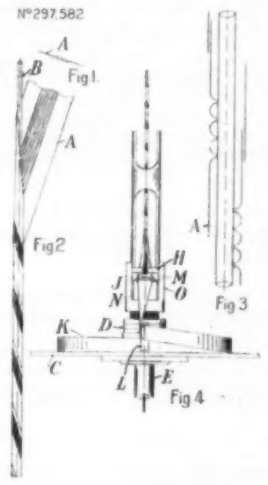
Copies of Specifications may be obtained at the Patent Office Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C. at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

TELEGRAPHS AND TELEPHONES.

297,582. October 12th, 1927.—Improvements relating to the Insulation of Electric Conductors, Siemens Brothers and Co., Ltd., of Caxton House, Tothill-street, London, S.W. 1, and Edward Rodney Hubbard, of Manor Lodge, Upper Brockley-road, Brockley, London, S.E. 4.

This invention relates to the insulation of the conductors of air space cables, such as are used for telephonic transmission purposes. The tape A, Figs. 1 and 2, is provided with grooves, and when wrapped round the core or conductor the tape appears as shown in Fig. 2, where the core is indicated at B. As the tape is wrapped on, the grooves close somewhat, forming a number of air-enclosing cells, bounded by the surface of the core. Fig. 3 gives a view of the approximate form of the cells on an enlarged

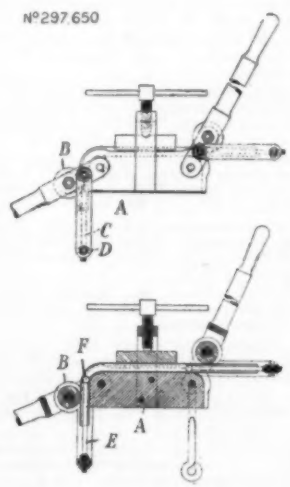


scale; whilst Fig. 4 shows the essential parts of a wrapping machine. C is a plate of annular shape, the boss D of which is mounted on a revolving hollow spindle E. The core to be wrapped passes through the spindle E from below and after wrapping is taken away to a drum. A fork-shaped fitting is screwed into the boss D, and carries a pair of rotatably mounted rollers, which are grooved and inter-mesh. One of the rollers H is visible in the drawing, with its grooves or teeth J. The paper tape passes between the two rollers immediately before application to the core, and is thereby grooved. The plate C supports a roll K of paper tape, which is passed over the boss D and the outer end of the roll is led round a guide arm L on the plate through a slot M in a tongue N fixed on the forked fitting O.—*September 27th*, 1928.

MACHINE TOOLS AND SHOP APPLIANCES.

297,650. April 2nd, 1928.—Pipe-bending Machines, L. Shakesby, 3, Butts-road, Barton-on-Humber.

This machine, it is claimed, is specially convenient for the bending of such tubes as the handle bars of bicycles. With it the actual bending is effected round a former A, by means of a lever and grooved roller B. The peculiarity of the arrangement lies in the addition of the pair of links C, pivoted to the lever at the radius of curvature. These links are connected together by a yoke at D, to which there is attached a rod E. This rod is

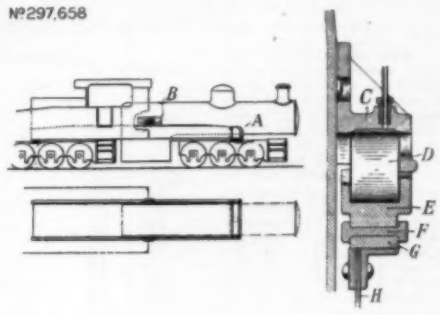


inserted in the tube to be bent and terminates in a hardened steel ball F, which prevents the tube from collapsing as it is bent. In the words of the inventor: "The part this ball plays is equal to a drawing operation, the ball acting as the bending is being done; this draws the metal on the outside of the tubing round the bend, and compresses the metal on the inside of the tubing round the bend, and in this manner equalises the strain put on the tubing, thus retaining its original shape."—*September 27th*, 1928.

TRAMWAYS AND RAILWAYS.

297,658. April 23rd, 1928.—Locomotive Boiler Supports, G. Goldschmid, 3, Place Stephanie, Brussels, and A. Weber, 22, rue Omer Lefebvre, La Louvière, Belgium.

This invention is concerned with the support of the boiler of an articulated locomotive, having two bogies connected together by a rigid framework. The object is to prevent the boiler being strained by the distortion of the main frame. To this end it is provided with a three-point support. One of these points is the rigid connection A with the framework, beyond

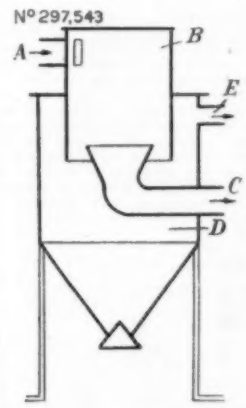


which, it will be noticed, the boiler overhangs considerably. At the fire-box end there are two supports, one on either side, one of which is indicated at B, while its construction is illustrated by the detail sketch. It comprises a riveted plate C, forming a semi-circular shell, and resting on a roller D, which, in turn, is supported by a slide, the upper portion E of which is shaped as a semi-circular bearing for the roller D, while its base F forms a flat shoe slidably engaging the flange G of the girder of the frame H.—*September 27th*, 1928.

LIGHTING AND HEATING.

297,543. July 23rd, 1927.—Extraction of Dust from Gas, T. Thomson, Hermiston, West Cliff-gardens, Scunthorpe, Lincs., and N. Nisbet, 9, Thoresbury-avenue, Scunthorpe.

This apparatus is a combination of the familiar cyclone separator with a gravity separator. Dirty gas is brought in by the tangential inlet A, and is separated by centrifugal action

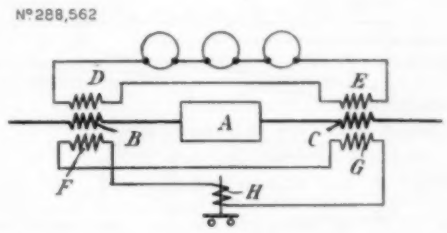


in the chamber B. The clean gas is drawn away at the outlet C. The dust and remaining dirty gas pass down into the lower receptacle D, where the dust falls to the bottom and the gas is sucked away at E. One of the essential features is the provision of a suction at E of such a magnitude that dirty gas cannot pass into the outlet C.—*September 27th*, 1928.

MISCELLANEOUS.

288,562. October 15th, 1927.—Differential Protective Systems for Electrical Machinery and Apparatus, Allmänna Svenska Elektriska Aktiebolaget, of Västerås, Sweden.

For indicating such faults in electrical machinery or apparatus which cause an internal leakage of current, for example, between different poles of a dynamo-electric machine or from one pole to earth, relays are employed which are differentially actuated by the incoming and outgoing current in each pole, or phase—for instance, by means of two current transformers, the primaries of which are inserted in conductors on either side of the machine or apparatus which are normally intended to carry equal currents. As the current transformers have hitherto been arranged, however, it has generally not been desirable to utilise them

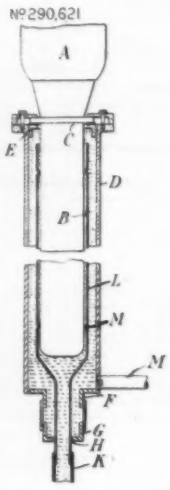


for other purposes than that referred to, because that would result in an unsymmetrical load with a risk of an undue operation of the differential protective device. This specification describes an arrangement for enabling the current transformers for differential protection also to be employed for other purposes without causing the inconveniences. A is the machine or apparatus to be protected, B and C the primaries of the two current transformers, D and E coacting secondaries and F and G counteracting secondaries. H is the relay actuated by the latter. With this arrangement undue releases are excluded as long as the current transformers are exactly equal. If the circuit formed by the two windings F and G is, for instance is assumed to be open, and the primary currents equal, the resultant ampère-turns must be exactly equal in both current transformers,

because the primary currents and also the secondary currents are equal in both transformers, and their sums, which are equal to the resultant ampère turns, must therefore also be equal. If the magnetic properties of the two transformers are exactly the same, the fluxes produced by these ampère turns, and, consequently, the voltages induced in each of the windings F and G will also be equal. No current can flow if the circuit so formed is closed, the windings being so connected that the induced voltages oppose each other.—*September 27th*, 1928.

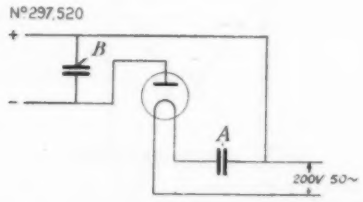
290,621. April 4th, 1928.—Improvements in and relating to Cooling Devices for Electric Discharge Devices, *The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, London, W.C. 2.*

The drawing shows an electric discharge device of about 100-kW capacity, having the usual upper glass sleeve portion A, and a lower copper anode B provided with a flange C. The anode B is surrounded by a relatively heavy metal casing or water jacket D, which has an inner flange E at its upper end, on which the flange C of the discharge device may be clamped in any suitable manner. The lower end of the jacket D is provided with a downwardly extending flange F, to which a cup-shaped member G, provided with an opening H, is flexibly attached by means of a rubber or other suitable connector. A thin metallic sleeve or casing L extends through the opening H, the upper end of the sleeve being enlarged and having a diameter slightly larger than the diameter of the anode B. At various points on the sleeve, the metal is indented, as indicated at M, to space the sleeve from the anode and to provide point contacts. A flexible hose K may be attached to the lower end of sleeve L, while a second hose — not shown — may be attached to the output pipe M, mounted in the lower end of the casing or water jacket D. By supplying the cooling fluid direct to the inner sleeve, a high velocity of flow of the cooling fluid adjacent to the device is obtained, and the flexible connection between the sleeve and casing allows the sleeve to take up its desired position around the device, irrespective of the position of the other casing.—*September 27th*, 1928.



297,520. July 7th, 1927.—A Unit Comprising Means of Improving the Efficiency of Small Rectifying Devices, Philip Ray Coursey, of Stamford House, Marchmont-road, Richmond, Surrey, and Humfrey Andrewes, of 8, North-grove, Highgate, London, N. 6, and the Dubilier Condenser Company (1925), Ltd., of Ducon Works, Victoria-road, North Acton, London, W. 3.

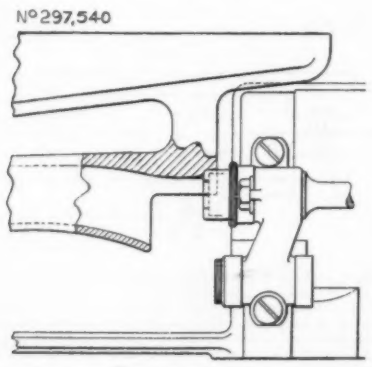
It is well known that with the small transformers used in battery eliminators or devices for supplying energy to radio receiving sets from alternating-current supply mains, owing to the large ratio of the magnetising current to the full-load current and other factors, the efficiency of such transformers is usually poor. According to this invention a considerable



improvement in the efficiency of a small rectifying device is obtained. Use is made of the impedance of a condenser A to supply the necessary current to the filament of the rectifying valve. The condenser B is the usual output smoothing condenser. The capacity of the condenser will be of a fairly large value, as the filament current will be of the order of 0·5 ampère. As, however, the power factor of the condenser will be quite small, the losses in the condenser will be negligible, and the power consumed will only be that required to heat the filament. With high-voltage supply mains, no transformer for the anode potential of the rectifying valve is necessary. In the case of 100-volt or similar low-voltage alternating-current supply, another circuit is described.—*September 27th*, 1928.

297,540. July 20th, 1927.—Gas Burners, Radiation, Ltd., Thimble Mill-lane, Birmingham, and H. J. Yates, 15, Grosvenor-place, London, S.W. 1.

The aim in designing this gas burner has been to reduce fluctuations of the flame when the rate of combustion is reduced



below the normal. This result has been attained by a consideration of aerodynamics, and is, in essentials, the provision of a stream-lined form for the gas and the air necessary for its combustion. The drawing plainly indicates such a form of construction.—*September 27th*, 1928.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

TO-DAY.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Informal meeting. "Marketing Engineering Products Overseas," introduced by Mr. E. T. Elbourne. 7 p.m.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. Annual general meeting. 7.30 p.m.

Keighley Association of Engineers.—Room 14, Temperance Institute, Keighley. "Precise Length and Angular Measurement," by Mr. C. H. Carter. 7.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. "Town Water Supply in India," by Mr. J. W. Madeley. 4.30 p.m.

The Faraday Society.—In the Lecture Theatre of the Royal Institution, Albemarle-street, London, W. 1. The first Spiers Memorial Lecture, "Some Debatable Problems in Physics," by Sir Oliver Lodge, F.R.S. 3.30 p.m.

The Institute of Metals: Sheffield Local Section.—In the Non-ferrous Section, Applied Science Department, the University, St. George's-square, Sheffield. "Flow in Metal Shaping Processes," by Professor F. C. Thompson. 7.30 p.m.

The Physical Society.—At the Imperial College of Science, Imperial Institute-road, South Kensington, S.W. 7. "The Effect of Moist Air on the Resistance of Pencil Lines," by Mr. J. B. Seth, Mr. Chetan Anand, and Mr. Gian Chand; "An Absolute Current Balance having a Simple Approximate Theory," by Dr. L. F. Richardson, F.R.S., Mr. V. Stanyon, and other Students of Westminster Training College; "Notes on Wireless Methods of Investigating the Electrical Structure of the Upper Atmosphere: I.," by Mr. E. V. Appleton, F.R.S. 4.45 p.m. Editing Committee meeting, 3.30 p.m.; Council meeting, 4 p.m.

SATURDAY, NOVEMBER 10th.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Planets," II., by Rev. T. E. R. Phillips. 3 p.m.

MONDAY, NOVEMBER 12th.

Bradford Engineering Society.—Technical College, Bradford. "The Atkinson Rotary Furnace and Inclined Chain Grate Stoker," by Mr. J. S. Atkinson. 7.30 p.m.

Chadwick Public Lectures.—Lecture Hall of the Institution of Civil Engineers, Great George-street, Westminster, S.W. 1. "Some Aspects of the London Water Supply," by Mr. H. E. Stilgoe. 8 p.m.

Institution of Automobile Engineers.—Queen's Hotel, Birmingham. Joint meeting of the Birmingham and Coventry Centres. Presidential address. "The Integrity of the Technical Man," by Mr. L. H. Housfield. 7 p.m.

Institution of Electrical Engineers.—Victoria Embankment, London, W.C. 2. Informal meeting. Discussion on "Engineering Requirements of a Modern Office Building," opened by Mr. J. Coxon. 7 p.m.

Institution of Electrical Engineers: North-Eastern Students' Section.—Armstrong College, Newcastle-on-Tyne. "Ignition Systems on Automobiles," by Professor S. Parker Smith. 7 p.m.

Institution of Electrical Engineers: South Midland Centre.—The University, Edmund-street, Birmingham. "The Action of a Spark Gap," by Dr. J. D. Morgan. 6.15 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Biology and Refrigeration: Lecture I.," by Dr. Franklin Kidd. 8 p.m.

Societe des Ingenieurs Civils de France.—Institution of Mechanical Engineers, Storey's Gate, S.W. 1. "Twin Gyro Stabiliser," by M. Fieux, M. Soc. C.E. (France). 5.30 p.m.

The Institute of Metals: Scottish Local Section.—In the Rooms of the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank-crescent, Glasgow. "Nickel in the Non-ferrous Foundry," by Mr. A. C. Sturney. 7.30 p.m.

The Surveyors' Institution.—12 Great George-street, Westminster, S.W. 1. Presidential address by Mr. C. B. Fisher. 8 p.m.

TUESDAY, NOVEMBER 13th.

Institute of British Foundrymen: Lancashire Branch, Burnley Section.—Municipal College, Ormerod-road, Burnley. "Mould Gases," by Mr. E. Flower. 7.15 p.m.

Institute of Marine Engineers.—85/88, The Minories, Tower Hill, London, E. 1. "Air Transport," by Major R. H. Mayo. 6.30 p.m.

Institution of Automobile Engineers.—Broadgate Café, Coventry. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7.30 p.m.

Institution of Petroleum Technologists.—At the House of the Royal Society of Arts, John-street, Adelphi, W.C. 2. "Drilling and Production Methods in the Greater Seminole Field, Oklahoma, U.S.A.," by Mr. George Heseldin. 5.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. "The Electrification of the Pietermaritzburg-Glencoe Section of the South African Railways," by Mr. F. Lydall. 7 p.m.

Manchester Geological and Mining Society.—5, John Dalton-street, Manchester. "The Grading and Sampling of Coal," by Mr. Neville Simpson. 4 p.m.

Royal Institution of Great Britain.—21, Albemarle-street, London, W. 1. "The Change of State from Liquid to Vapour: Lecture III.," by Professor H. L. Callendar. 5.15 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "Some Factors in Fuel Economy," by Mr. James Cunningham. 7.30 p.m.

University of London.—University College, Gower-street, London, W.C. 1. "High-tension Transmission of Power," Lecture I., by Mr. Percy Dunsheath. 6.30 p.m.

WEDNESDAY, NOVEMBER 14th.

Belfast Association of Engineers.—Central Hall, Municipal College of Technology, Belfast. "Low-pressure Hot Water Heating," by Mr. A. W. Brown. 7.30 p.m.

Institution of Chemical Engineers.—In the Lecture Theatre of the Institution of Civil Engineers, Great George-street, Westminster, London, S.W. 1. "Making Rubber Goods of Latex by Electro-deposition," by Dr. Paul Klein, of Budapest. 6.30 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Informal meeting. "Measurement of Noise and Vibration and its Application to the Investigation of the Noise Nuisance," by Mr. J. H. Hyde. 6 p.m.

Institution of Civil Engineers: Manchester and District Association.—36, George-street, Manchester. "The Manufacture of Iron and Steel," by Mr. J. H. Jameson. 6.45 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Grand Hotel, Sheffield. "Corrosion of Metals and its Prevention," by Mr. H. E. Yerbury. 7.30 p.m.

THURSDAY, NOVEMBER 15th.

Institution of Automobile Engineers.—Watergate House, Adelphi, London, W.C. 2. Informal meeting of London Graduates. "The Application of Presswork to the Motor Cycle," by Mr. P. A. Walker. 7.25 p.m.

Institution of Automobile Engineers.—Joint meeting with the Royal Aeronautical Society at the Royal Society of Arts, John-street, Adelphi, London, W.C. 2. "Aero-engine Problems in Flight," by Mr. R. J. Penn. 7.45 p.m.

Institution of Mechanical Engineers: Yorkshire Branch.—Hotel Metropole, Leeds. "Corrosion of Metals and its Prevention," by Mr. H. E. Yerbury. 7.30 p.m.

North-East Coast Institution of Engineers and Shipbuilders.—Bolbec Hall, Newcastle-upon-Tyne. "Losses of Efficiency in Steamship Operation," by Mr. J. Denholm Young. 6 p.m.

The Institute of Metals: Birmingham Local Section.—In the Engineers' Club, Waterloo-street, Birmingham. Open discussion on "Standardisation." 7 p.m.

FRIDAY, NOVEMBER 16th.

Institution of Engineers and Shipbuilders in Scotland.—Grosvenor Restaurant, Gordon-street, Glasgow. The "James Watt" Lecture.

Institution of Locomotive Engineers: North-Eastern Centre.—Hotel Metropole, Leeds. "The Locomotive Smokebox," by Mr. E. Windle. 7 p.m.

Institution of Mechanical Engineers.—Storey's-gate, St. James's Park, Westminster, London, S.W. 1. "Power Transmission by Belts: An Investigation of Fundamentals," by Dr. H. W. Swift. 6 p.m.

Junior Institution of Engineers.—39, Victoria-street, Westminster, London, S.W. 1. Informal meeting. "Some Applications of Time and Remote Control Switches," by Mr. A. H. Croucher. 7.30 p.m.

SATURDAY, NOVEMBER 17th.

Institute of British Foundrymen: Lancashire Branch, Junior Section.—College of Technology, Sackville-street, Manchester. "Shrinkage Holes in Small Grey Iron Castings," by Mr. P. A. Russell. 7 p.m.

MONDAY, NOVEMBER 19th.

Institution of Automobile Engineers.—At the College, Loughborough. Graduates' meeting. "Servo Equipment," by Mr. C. K. Speid. 7 p.m.

Institution of Automobile Engineers: Scottish Centre.—Royal Technical College, Glasgow. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7.30 p.m.

Institution of Mechanical Engineers.—Storey's-gate, Westminster, S.W. 1. Graduates' Section, London. "Automatic Combustion Control of Furnaces," by Mr. G. R. Bamber. 6.30 p.m.

Royal Society of Arts.—John-street, Adelphi, London, W.C. 2. Cantor Lecture. "Biology and Refrigeration: Lecture II.," by Dr. Franklin Kidd. 8 p.m.

TUESDAY, NOVEMBER 20th.

Institution of Automobile Engineers.—Broadgate Café, Coventry Graduates' meeting. "Automobile Brakes," by Mr. L. H. Dawtrey. 7.15 p.m.

Institution of Automobile Engineers.—Engineering and Scientific Club, Queen-street, Wolverhampton. "The Comparative Merits of Road and Dynamometer Testing for Motor Vehicles," by Dr. E. C. Wadlow. 7.30 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. "Mechanical Properties of British Rail Steels," by Professor W. E. Dalby, F.R.S. 6 p.m.

Sheffield Metallurgical Association.—198, West-street, Sheffield. "The Welding of Stainless Materials," by Mr. H. Bull and Mr. L. Johnson. 7.30 p.m.

WEDNESDAY, NOVEMBER 21st.

Institute of Fuel.—Connaught Rooms, London, W.C. 2. Annual dinner. 7.15 p.m.

Institution of Automobile Engineers.—Savoy Hotel, Victoria Embankment, W.C. 2. Annual dinner and dance. 7 p.m.

Institution of Civil Engineers.—Great George-street, London, S.W. 1. Students' meeting. Address by Mr. H. G. Cousins. 6.30 p.m.

Newcomen Society.—At the Iron and Steel Institute, 28, Victoria-street, London, S.W. 1. Annual general meeting. "Statistical History of the Iron Trade, A.D. 1717–1765," by Mr. E. Wyndham Hulme. 5.30 p.m. Council meeting at 4 p.m.

WEDNESDAY AND THURSDAY, NOVEMBER 21st AND 22nd.

Institute of Fuel.—At the Institution of Electrical Engineers, Victoria Embankment, London, W.C. 2. November Conference. For programme, see page 528.

THURSDAY, NOVEMBER 22nd.

Institution of Civil Engineers: Birmingham and District Association.—Birmingham Chamber of Commerce. "Notes on a Storm Water Pumping Plant," by Mr. R. C. Moon. 6 p.m.

Institution of Structural Engineers.—10, Upper Belgrave-street, S.W. 1. "Recent Improvements in the Strength and Constructive Value of Portland Cement," by Mr. B. B. Butler. 6.30 p.m.

FRIDAY, NOVEMBER 23rd.

Junior Institution of Engineers.—39, Victoria-street, London, S.W. 1. "A Survey of Cadmium," by Mr. C. F. Moore. 7.30 p.m.

Keighley Association of Engineers.—Queen's Hotel, Keighley. Ladies' night. "Romantic Britain," by Mr. J. Shuttleworth. 7.30 p.m.

Manchester Association of Engineers.—Engineers' Club, Albert-square, Manchester. "Electric Traction on Railways," by Mr. R. Brooks. 7.15 p.m.

SATURDAY, NOVEMBER 24th.

Institution of Civil Engineers.—Students' visit to the reconstruction works of Waterloo Bridge.